





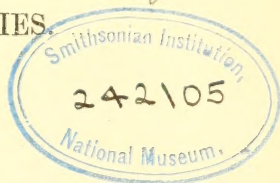
THE ANNALS
AND
MAGAZINE OF NATURAL HISTORY,

INCLUDING
ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND
CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY
ALBERT C. L. G. GÜNTHER, M.A., M.D., Ph.D., F.R.S.,
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AND
WILLIAM FRANCIS, Ph.D., F.L.S.

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VOL. III.—SIXTH SERIES.  
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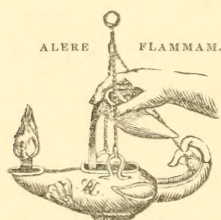
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"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exulta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.



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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

"..... per litora spargite museum,
Naiades, et circum vitreos considite fontes:
Pollice virgineo teneros hic carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. 1.

No. 13. JANUARY 1889.

I.—*A Preliminary Notice of a Stalked Bryozoon* (*Ascorhiza occidentalis*). By J. WALTER FEWKES.

[Plate I.]

THE number of genera of Bryozoa which people the waters of the coast of California is very great, and their study is a most fertile field for research. While there seems to be a great difference in the Bryozoan fauna of the Atlantic and Pacific shores of the United States, we find many genera common to both.

In an investigation of the marine Invertebrata, carried on at Santa Barbara*, my attention was turned to the great variety in the forms of Bryozoa which inhabit the Santa Barbara Channel. Many of these animals there grow to a large size and are sometimes found in huge masses, which are known as corals to the few fishermen who sail on these waters.

* I am indebted to Mr. Augustus Hemenway, of Boston, Massachusetts, for opportunities of carrying on studies in marine zoology on the coast of California.

A report on the Invertebrata collected on the coast of California, in which a more extended account of *Ascorhiza* will appear, will soon be published for me in the 'Bulletin' of the Museum of Comparative Zoology at Cambridge, Massachusetts.

In dredging just outside the zone of kelp in this channel there was brought up by the dredge a most exceptional genus of Bryozoa, which seems to me to present more than usual interest to students of the morphology of this group of animals. For this strange organism the name *Ascorhiza* is proposed.

The most marked peculiarity of the genus is the massing of the zoarium into a spherical or oval capitulum *, mounted on a jointed stem, which is flexible and highly sensitive to the touch (Pl. I. fig. 1). While it cannot be said positively that the specimen here described is an adult, and although there are several features which remind one of an immature animal, I am confident that a similar Bryozoon has never been described from the Atlantic sea-board of the United States and that nothing like it is recorded from European seas.

The following description of *Ascorhiza* may give an idea of its external form and exceptional anatomy.

Ascorhiza occidentalis, gen. et sp. nov.

Ascorhiza was dredged † in 20 fathoms of water in the channel off the island of Santa Barbara. While examining a small rock brought up in the dredge there was detected upon it an organism which had the form of a small sac mounted on a slender stalk. I was at first at a loss to know whether the organism was an animal or a plant. Its colour is almost identical with that of the huge kelp so abundant at Santa Barbara; but when put into a glass vessel and irritated with a needle it was seen to sway slowly backwards and forwards and even to double its stem on itself. A study of the specimen with a hand-lens told the true story of its animal affinities.

It is believed to be a new genus allied to certain Bryozoan genera, some of which occur in shallow seas, some in the deep oceans, and one at least in fresh water.

The whole animal is about an inch in height and has the form of a fleshy globular sac mounted on a stem (fig. 1, s). The colour is a brownish red and is uniform throughout‡.

* Mr. R. Kirkpatrick has suggested the term "capitulum" for this club-shaped structure. I am indebted to him for several valuable suggestions in the preparation of this account of *Ascorhiza*.

† The shore of the Pacific at Santa Barbara is lined by a broad zone composed of the huge fronds of a giant Alga. This zone is situated several hundred feet from the shore and marks the inner limit of shallow-water dredging. Between the inner edge of this zone and the shore it is next to impossible to dredge.

‡ The colour closely approximates to that of the giant kelp (*Macrocystis*).

The capitulum (fig. 1, *b*) is ovate, fastened to the stem at one pole and carried with its longest axis upright. Its surface is almost smooth or covered with small warts, but without marked elevations to denote the presence of the polypides. When kept in confinement it was impossible for me to get the wary polypides to extend themselves, and the openings on the surface of the body through which they could be extended were very difficult, or almost impossible, to discover. The wall of the capitulum is leathery, and through it extend delicate, pink-coloured, anastomosing fibres or threads (fig. 4). There are also many small yellow pigment-spots in its substance. The leathery covering of the capitulum, during life, is translucent. The polypides were easily found by a dissection of the capitulum of the Bryozoon. After many trials and repeated observations, in which it was impossible to see the polypides extended, incisions were made with the scalpel into the substance of the body, and the live polypides were found nicely packed away in its interior.

Each polypide (fig. 2) has a sac-like body fastened to the common attachment. The mouth is situated at the free end and is surrounded by a circle of tentacles. Many of the polypides seem to have their tentacles extending inwards, the mouth-openings pointing to the middle of the body.

I searched in vain for polypides on the stem; they seem to be confined to the body in all cases and to be absent from the stem. Each polypide has a transparent outer wall, with yellow-and-brown coloured stomach. At the base of the stomach there is a globular mass of unknown homology. The mouth-opening is entire and without cover. The tentacles are long, stiff, and not contractile, but are readily moved in all directions. Each tentacle has a central cavity and its outer wall is richly ciliated externally. They move very rapidly and often twist themselves into coils. Their manner of movement, ciliation, and stiffness recall the motion of tentacles of other well-known Bryozoan genera; but they have only a very remote likeness to the tentacles of the Hydrozoa.

Through the outer wall of the capitulum many wheel-like structures (fig. 3) were observed, which looked like immature polypides with their tentacles drawn together in such a way as to give a radiated appearance to these structures. These bodies are thought to be polypides with their tentacles par-

This resemblance, and the fact that it is found associated with small specimens of the Alga and among the "roots" of large specimens, may readily be interpreted to signify a protective resemblance.

tially developed. They are closely pressed together, especially near the lower pole, and seem to fill almost the whole interior of the capitulum.

The stem is of exceptional character and its structure in this genus of Bryozoa is believed to be unique. It consists of a long peduncle of uniform diameter fastened at one end to a foreign body, supporting at the free end the capitulum or colonial body of the animal. Like the body it also has a leathery character, and both have the same colour. The stem is carnose and composed of a number of segments of uniform size (fig. 6), the partitions or indentations between which are well marked.

The stem is very flexible and may be so bent as to bring the capitulum to the level of the attachment of the stem, forming a perfect coil or bow. It is sensitive to the touch and responds quickly when pinched or when in any way irritated. Its motion is always slow and graceful.

The stem is without appendages or lateral branches. Its basal joint is slightly expanded as a means of attachment; but the remaining segments are of uniform size.

The outer layer of the stem is translucent, pale brown, or amber-coloured. Through this superficial layer a number of longitudinal muscular blocks or cubes can be observed. The superficial fibres of these muscular blocks can also be easily seen. As the stem contracts the articulations of these blocks are more evident than when the stem is extended. The blocks of the stem near the body are polygonal and sometimes almost spherical. The indentations which mark the separate nodes of the stem are not the same nor do they correspond with those which limit the muscular blocks. The articulation is confined to the external layer of the stem, while the length of the muscular blocks does not correspond with the breadth of the articulations of the stem itself.

As in the genus *Aleyonidium*, when the polypides are retracted they are wholly drawn out of sight beneath the gelatinous or carnose coenosarc, and the tentacles are almost completely, if not wholly, hidden. This accounts for the fact that I have never seen the polypides extended beyond the coenosarc of the body.

What are the zoological affinities among Bryozoa of the genus *Ascorhiza*?

The carnose body recalls that of *Aleyonidium*, although it must be confessed that no adult Ctenostomatous Bryozoon has yet been described with a stalk similar to the stem of *Ascorhiza*.

Ascorhiza differs also from the Entoproctous genera *Pedi-*

cellina, *Loxosoma*, and *Urnatella* in its colonial character. It is not difficult, however, to see how we might find among known genera a homologue of the capitulum of *Ascorhiza* in the freshwater genus *Urnatella* described by Dr. Leidy.

The polyp-head of *Urnatella* may be supposed in *Ascorhiza* to be greatly enlarged and concentrated, so that the polypides are all brought together into a head or capitulum. We might then find in the stem of the *Ascorhiza*-colony the exact homologue of the articulated or jointed stem of *Urnatella*.

While, however, *Ascorhiza* differs from all known Entoproctous Bryozoa in the colonial form of the capitulum and the clustering of many zoecia in a compact mass, as in the Ctenostomata, we may look among the Entoprocta for a homologue of the stem. The stem of *Urnatella* closely resembles that of *Ascorhiza*, judging from the figures given by Dr. Leidy.

In *Ascopodaria* likewise, as figured in the Report on the 'Challenger' Bryozoa by Busk, we have at the base of the peduncle a barrel-shaped body, which in some particulars resembles the jointed stem of *Ascorhiza*. This barrel-like body forms a cup-shaped socket in which the base of the peduncle is placed, and lies at the very base of the peduncle. Its resemblance to the "jointed stem" of *Ascorhiza* is distant, for it is to be borne in mind that there is but a single zoecium on each peduncle in *Ascopodaria* and that the mouth and anus lie within the circle of the tentacles. The genus *Ascopodaria* has several remote resemblances to *Ascorhiza*.

A possible interpretation of the combination of features which we have in *Ascorhiza* is that the genus belongs to the Ctenostomata somewhere near *Aleyonidium*, but that it possesses what no genus of the Ctenostomata known to me has — a sensitive, flexible, jointed stem. It seems also probable that this stem is homologous with the stem of *Urnatella* and more distantly related somewhat to the barrel-shaped structure of the peduncle of *Ascopodaria*. If these comparisons are good and there is a true homology between the structures in question it is probable that we have in *Ascorhiza* a genus with characters of both the great orders or divisions of Bryozoa. So markedly different are the structural peculiarities of *Ascorhiza* and so characteristic is the stem that it may be necessary to make a new family for its reception.

From the limited knowledge of the anatomy of the polypides of *Ascorhiza* I am unable to refer it to either the Ctenostomata or the Chilostomata. In external form the colony is very different from anything found in either group. It is

very desirable that more should be ascertained of the structure of the polypides, as a study of their anatomy is necessary before the structural relations of the animal can be made out.

EXPLANATION OF PLATE I.

Fig. 1. View of *Ascorhiza* (entire). *a*, foreign body, to which the stem of *Ascorhiza* is attached; *b*, capitulum or club-shaped zoarium; *d*, brown bodies seen through the external walls of the capitulum; *s*, stem or stalk, showing its joints.

Fig. 2. Polypide of *Ascorhiza* (very much magnified).

Fig. 3. Two neighbouring polypides (young) with tentacles retracted.

Fig. 4. Single polypide with retracted tentacles, showing the network of tubes on the external surface of the capitulum.

Fig. 5. Distal end of the stalk adjoining the capitulum.

Fig. 6. Portion of the stalk, showing longitudinal muscles of two joints.

Cambridge, Mass., U. S. A.,
May 1888.

II.—Contributions to our Knowledge of the Crustacea of Dominica. By R. I. Pocock, of the British Museum (Natural History).

[Plate II.]

THE Crustacea forming the subject-matter of the present paper were collected by Mr. G. A. Ramage, who has been engaged in the investigation of the fauna and flora of the Lesser Antilles for the West-Indies Exploration Committee.

In addition to the land and freshwater forms, which constitute the greater part of the collection, specimens of the following wide-spread Antillean and Central-American littoral species were sent home:—

Mithrax spinosissimus, Lamarck.

Carpilius corallinus, Herbst.

Grapsus maculatus, Catesby.

Cenobita diogenes, Latreille.

BRACHYURA.

Gecarcinus lateralis, Freminville.

Gecarcinus lateralis, Freminville, Milne-Edwards, Hist. nat. Crust.
ii. p. 27, pl. xviii. fig. 1.

Eight specimens, collected near the sea on Point Michelle.

Gecarcinus ruricola, Linn.

Gecarcinus ruricola, Linn., Milne-Edwards, *loc. cit.* p. 26.

One specimen.

Sesarma americana, de Saussure.

Sesarma americana, de Saussure, Mém. Crust. nouv. du Mexique et des Antilles, p. 25.

Ten specimens from Laiou (freshwater).

Pseudotelphusa tenuipes, sp. n.

Carapace wide and moderately flat, very finely but not closely punctured; gastric region slightly convex from before backwards and from side to side, furnished in front with two faint, low, slightly roughened epigastric lobes, between which runs forward a shallow median sulcus which divides into two halves the superior frontal crest. Anterior portion of the front almost vertical and bounded above and below by conspicuous bluntly denticulated crests, of which the inferior is less conspicuous; the superior and inferior crests nearly straight and parallel, the distance between them being equal to one eighth of the greatest width of the area that they define. Orbits large, their length being nearly equal to two thirds of their width and to half the width of the frontal area, with bluntly denticulated margins. Antero-lateral borders of the carapace evenly rounded and conspicuously dentate, the dentations becoming smaller in front and gradually disappearing behind. Cervical groove well marked and straight, but not quite reaching the margin of the carapace; the gastro-branchial sulci very shallow; the branchial region evenly convex, the cardiac region nearly flat, and the cardio-branchial sulci not or scarcely visible; margin of the carapace between the posterior legs very slightly concave. The subhepatic and anterior pleural regions of the carapace smooth.

Chelipedes sparsely granular or tubercular, unequal in size, and differing in shape.

Merus triangular, superior surface slightly concave proximally, anterior surface nearly flat, inferior surface convex; anterior surface bordered below by a conspicuous series of rounded tubercles and above by a series of nine or ten large conical teeth, which distally increase in size; posterior edge of the superior surface bluntly toothed proximally, the teeth distally passing into ridges.

Carpus rounded above and behind, furnished anteriorly (inwardly) with one strong tooth, behind which are three or four much smaller teeth.

Small hand with straight superior and inferior surfaces and gently convex anterior (inner) and posterior (outer) surfaces; fingers curved gently forwards (inwards) distally, but otherwise tolerably straight; almost in contact when closed.

The *larger hand* is relatively thicker from above downwards, the inferior surface is slightly convex distally, and the dactylus convex from base to point. In the adult male the difference between the two hands is more pronounced than in the female and the space between the fingers much larger.

Legs long and slender, feebly dentate or spinous above, propodus sparsely spinous below; dactylus slender, arched, furnished with five rows of spines which distally increase in size, as long as the propodus and half the carpus; propodus with a row of distal marginal spines.

Abdomen in the female covering the entire sternum as far as the space between the chelipedes, and touching the coxæ of the legs on each side; fringed with hairs on each side. The appendages decrease in length from before backwards, and are long and feather-like, being fringed with hairs. The endopodites of all are alike, being slender proximally for two thirds of their length, foliaceous and ovate for the distal third; the exopodite of the first resembles the endopodites, but those of the second, third, and fourth gradually alter in shape from before backwards, the fourth being broad and laminate. The lateral angular portions of the sternum which project between the coxæ are fringed with hairs, and there is a single patch of hair on each side opposite the coxa of the chelipede. The generative apertures are almost in contact in the middle line. In the male the sides of the sternum and of the abdomen are furnished with very short hairs, and there is no anterior patch of hair on each side; but the triangular hollow which contains the abdominal appendages when the abdomen is closed over it is covered with longish hairs. The abdominal appendages, though apparently more complex, closely resemble those of *P. dentata* as figured by Brocchi (Ann. Sci. Nat. (6) ii. p. 86, pl. xvii. figs. 119-121), consisting of a posterior, slender, styliform process, and an anterior stouter process which is completely twisted at its distal end.

In both sexes the pterygostomial region is covered thickly with short hairs.

Measurement in millimetres of largest (♂) specimen.

| | Length. | Breadth. | Height. |
|--------------------|-----------------|----------|---------|
| Carapace | 57 | 95 | |
| Orbit..... | 10 | 15 | |
| Frontal area | 2 $\frac{1}{2}$ | 20 | |

Smaller chelipede (measured along upper surface):—

| | | | |
|----------------|------------------|------------------|------------------|
| Merus | 42 | 27 $\frac{1}{2}$ | 16 |
| Carpus | 24 | 15 $\frac{1}{3}$ | 18 |
| Propodus | 31 $\frac{1}{2}$ | 16 | 24 $\frac{1}{2}$ |
| Dactylus | 42 $\frac{1}{2}$ | | |

Hand of larger chelipede:—

| | | | |
|----------------|------------------|------------------|----|
| Propodus | 44 | 25 $\frac{1}{2}$ | 39 |
| Dactylus | 54 $\frac{1}{3}$ | | |

First leg along upper surface:—

| | | | |
|----------------|------------------|-----------------|------------------|
| Merus | 37 $\frac{1}{2}$ | 7 $\frac{1}{2}$ | 10 $\frac{1}{3}$ |
| Carpus | 20 $\frac{1}{2}$ | 8 | 9 |
| Propodus | 20 | 5 $\frac{1}{2}$ | 9 |
| Dactylus | 30 | 2 $\frac{1}{2}$ | 3 |

I am very much inclined to think that these specimens may be referable to *P. dentata* of Milne-Edwards, but I have never seen either a specimen or a full description of that species, and have been consequently compelled to rely upon the figure of it on pl. xviii. of Milne-Edwards's Hist. nat. Crust. This figure represents the dactyli as not longer than the propodal segments of the appendages, and the length of each is not more than five times as great as the height.

Twelve specimens were obtained, four of which were taken on the land at Laudat, at an altitude of about 1000 feet; for the rest no special locality was mentioned.

The following is, I believe, a complete list of the remaining species of the genus *Pseudotelphusa*:—

P. dentata (Latr.), Edwards, Hist. nat. Crust. ii. p. 15, pl. xviii. fig. 14.—The long and slender dactyli of *tenuipes* serve to separate it from this species. In other respects the two seem to be closely allied.

P. latifrons (Randall).—Mr. Kingsley (Proc. Acad. Nat. Sci. Phil. 1880, p. 34) asserts that this species may be recognized at once by its reflexed front and large antero-lateral teeth.

P. chilensis, Edwards, Crust. du voyage d'Orbigny, p. 22, pl. x. fig. 1.—The inferior frontal crest is smooth and the

regions of the carapace are much more sharply defined than in *tenuipes*.

P. macropa, Edwards, Arch. du Mus. vii. p. 175, pl. xii. fig. 3.—Closely allied to *tenuipes*, but has the lateral margins of the carapace not denticulated.

P. denticulata, Edwards, Ann. Sci. Nat. Zool. (3) xx. p. 208.—The superior frontal crest is not bilobed and the merus of the chelipedes is feebly dentate.

P. americana, Saussure, Mém. Crust. Nouv. des Ant. et du Mex. p. 20, pl. ii. fig. 12.—In this species there is no superior frontal crest and the orbits and margins of the carapace are without denticulations.

P. Bocourti, A. Edwards, Ann. Soc. Ent. Fr. (4) vi. p. 203.—The frontal crests are smooth.

P. gracilipes, id. ibid. p. 204.—This species apparently resembles *tenuipes* in the form of the legs, but there is scarcely a trace of the superior frontal crest.

P. sinuatifrons, id. ibid. p. 205.—The inferior frontal crest is sinuous and the inferior surface of the carapace is furnished with a series of granules.

P. plana, S. I. Smith, Trans. Conn. Acad. ii. p. 146.—Apparently allied to *tenuipes*, but differing in the form of the merus, which is said to be short and *slightly* dentate.

MACRURA.

Palæmonidæ.

Bithynis jamaicensis, Herbst.

Palæmon jamaicensis, Herbst, Naturg. der Krabben, ii. p. 57, pl. xxvii. fig. 2; Milne-Edwards, Crust. ii. p. 398; v. Martens, Arch. f. Naturg. 1869, p. 22.

Thirteen small specimens taken at Laiou.

Bithynis spinimanus, M.-Edwards.

Palæmon spinimanus, M.-Edwards, Crust. ii. p. 399; von Martens, Arch. f. Naturg. 1869, p. 26.

A single specimen from Laiou.

? *Bithynis appuni*, von Martens.

Palæmon appuni, von Martens, Arch. f. Naturg. xxxv. p. 31, pl. ii. fig. 5.

A single specimen of a prawn taken at Laiou I refer with hesitation to the species described by Dr. von Martens from Porto Cabello, Venezuela.

In the Dominica individual the rostrum appears to be somewhat longer, inasmuch as it projects beyond the peduncle of the antennæ, and it is armed with thirteen teeth above, six of which are situated behind the orbit, and four beneath. Furthermore, the second pair of legs are considerably shorter; but although the segments are somewhat thicker, their relative length is almost the same as in *P. appuni*.

Atyidæ.

Atya occidentalis (Newport).

Atya occidentalis (Newport), Ann. & Mag. Nat. Hist. xix. p. 158 (1847).

Mr. Ramage sent home no less than thirty-two specimens of a species of *Atya*, all of which I believe to be referable to *A. occidentalis* (Newport). Twelve of these are from Laiou (freshwater) and the rest from Laudat, at an altitude of about 1000 feet. I take the opportunity afforded by the possession of a number of specimens to recharacterize a species which appears to be but little known, and I do this the more gladly since the specimens in question exemplify in a marked degree the value for the determination of species of the examination of a long series of forms, and show no less clearly how unsafe is the application of new names to isolated individuals which are obviously closely allied to species that have been previously described, when in the case of these species nothing, or next to nothing, is known respecting the variation which accompanies individuality or age. For it is certainly the case that from this series, by the careful selection of specimens exhibiting extremes of structural modifications and by the judicious elimination of those presenting features which fill up the interval between the extremes, material might be obtained amply sufficient to justify the establishment of no less than four species. But inasmuch as I can in no case detect a character which, owing to its constancy in some individuals and to its total absence in others, falls outside the probable limits of individual variation, I am compelled to consider the whole series to belong to one species. That this should be named *occidentalis* is shown by the close similarity between the medium-sized specimens obtained and the type of *occidentalis* which is preserved in the British Museum.

Body compressed, narrowed considerably behind, less so in front, widest across the anterior abdominal somite.

Carapace in the smallest specimens entirely smooth, naked or clothed more or less thickly at the sides with short close-set hairs, which are very easily removed by rubbing; in half-sized specimens showing faint shallow punctures at the sides, deeper punctures above; as the specimens increase in size so do the punctures increase in clearness, until in some of the largest the sides of the carapace are adorned with a reticulated pattern of smooth ridges, and its dorsal surface, where the confluence of the punctures is carried to an extreme, with isolated simple or branched ridges. In these specimens and some others where the pattern is of less complexity various smooth, symmetrically arranged tracts may be noticed on the dorsal surface. When clearly expressed these tracts present on each side the following arrangement:—one above, almost continuous in front with the lateral rostral groove, runs directly backwards and terminates in front of the middle of the carapace in a more conspicuous, circular, smooth area; behind and a little above this, sometimes confluent with it, sometimes separated from it by the interposition of one or more than one smooth ridge, there is a similar but less conspicuous area; beneath this superior, longitudinal, smooth tract, but separated from it by a row of ridges, is a second similar tract, which at about the middle of the carapace gradually breaks up into the interstices which separate the ridges; below this again, but taking its rise behind the anterior third of the carapace in a more conspicuous, vertically elongated, smooth area, there is a third tract, which runs backwards, at first upwards, then downwards, ultimately to disappear, in the same manner as the tract next above it, near the hind margin of the lateral portion of the carapace; this tract is separated below by a conspicuous arched ridge from the more thickly punctate or reticulated inferior lateral surface of the carapace. Laterally the carapace is smooth, where it is overlapped by the first abdominal somite; inferior edge of the carapace raised; anterior edge produced on each side into two sharp angular processes—one shorter immediately beneath the eye, the other, beneath the antennal peduncle, stretches as far or almost as far forwards as the apex of the rostrum.

Rostrum projecting slightly downwards beyond or not so far as the anterior margin of the proximal segment of the peduncle of the antennula, medianly keeled above and below; the superior keel separated by a depression from the supra-orbital portion, beyond which the rostrum is more or less sharply constricted and narrows rapidly to the apex; inferior keel usually feebly bidenticulate in front.

Ophthalmopods short, cylindrical, not narrowed at the base, separated from each other below by a small vertical plate.

Antennula.—Basal segment of peduncle more or less hairy, hollowed above at its proximal end, furnished externally with a large tooth which does not reach so far as its anterior margin; anterior margin armed with a series of strong spines interspersed with hairs; inferior surface flat, its inner edge forming a ridge, which terminates in front in a small tooth. Second segment about equal in length to the first, armed above with more or fewer small scattered spines and in front with a marginal series of spines interspersed with hairs; outer, inner, and under surfaces smooth, except for a series of hairs along the inner inferior edge. Third segment the shortest, armed above like the second with scattered spines and a marginal series, its inferior edge furnished with hairs, which are conspicuously long in front. The superior spines on the two segments which have been just described may in small specimens be wholly absent. The inner *flagellum* longer than the outer, slightly longer than the carapace, the outer slightly shorter.

Antenna.—Distal segment of peduncle cylindrical, not projecting quite so far forwards as the peduncle of the antennula, with a marginal series of hairs and small spines on its inner surface; externally beneath the scale there is a pointed process which projects about as far as the apex of the antennular spine. *Scale* with parallel edges, ovate in front, fringed on the inner edge and on the outer edge distally with long hairs, projecting beyond the antennular peduncle, bearing a small spine on the outer side. *Flagellum* when stretched backwards reaching about as far as the end of the body.

Pereiopods.—*First* and *second* pairs almost alike in form and size. Ischium running considerably forwards beneath the proximal half of the merus and with it constituting almost one segment; merus furnished externally above with a conspicuous, long, smooth sulcus; this ischio-meral segment externally hairy or smooth and in the larger specimens tubercular, the second pereiopod being more tubercular than the first; carpus, propodus, and dactylus also slightly tubercular or smooth; propodus and dactylus terminated with long tufts of hairs. *Third pereiopod* the largest, the ischio-meral segment longer than the three segments which succeed it taken together, flatter on the inner surface, rounded externally from above downwards. In the largest specimens covered externally more or less thickly with rounded or conical smooth tubercles, exhibiting a tendency to arrangement in longitudinal series; the inner surface is much more scantily beset

with smaller, more squamiform tubercles. In small specimens the tubercles are scarcely perceptible. The relative thickness of the segment varies much; in one large specimen its upper surface is very convex from behind forwards, and the thickness is almost equal to a third of its length. From this extreme there is every intermediate step until the thickness becomes less than one fifth of the length. The carpus is a little shorter than the propodus when measured along their external surfaces; both are covered with smooth, rounded or flattened, scattered or close-set tubercles, the inferior flattened surface of the carpus alone being without tubercles. Upper surface of the carpus produced distally into an evenly rounded process which overhangs the proximal end of the propodus; inferior half of propodus somewhat compressed. In small specimens the tubercles may be completely spiniform, and some of them show a remarkable development of these spines at the end of the propodus. Dactylus short, less than a third the length of the propodus, spined beneath, bearing a sharp claw. The carpus and propodus are more cylindrical and relatively more slender in small individuals.

The two succeeding pereopods much resemble that which has been just described, except that they are smaller and differ with regard to the relative length of their segments.

The ischio-merus of the fifth is shorter than that of the fourth, and the fourth shorter than that of the third. The carpal segments, however, vary considerably in length; thus, they may present in larger forms the same relative size as the ischio-meral segments, or they may in smaller forms be equal in the three pairs of appendages. The propodus, on the contrary, of the fifth pair is always longer than those of the other two, and the propodus of the fourth may be either equal to, less than, or greater than that of the third. The external surface of each of the ischio-meral segments is furnished distally with a small rounded prominence, which may or may not be armed with two or three small spines; the under surface of this segment in the fourth and fifth pairs is armed with an oblique series of three or four larger spines, which are naturally more visible in smaller specimens in which the tubercles are inconspicuous or absent, but more or fewer of them may have entirely disappeared in the largest specimens, probably having been converted by wear into tubercles. That the squamiform or tuberculiform armature of the largest specimens has been derived from the spiniform armature of the smaller specimens during the growth of the individual by some such process as rubbing seems certain from the frequent occurrence side by side in the same segment in larger

specimens of tubercles either tipped with spines or with smooth vertices. The interstices between the spines or tubercles of these three pereopods are more or less thickly clothed with short fine hair, and in some individuals there is a distinct series of long hairs running on the outside from the proximal to the distal end of the appendage.

Branchial Formula.

| Appendages. | Pleuro-branchia. | Mastigo-branchia. | Arthro-branchia. | Podo-branchia. | |
|--------------------|------------------|-------------------|------------------|----------------|-------|
| 2nd maxillipede .. | 0 | 0 | 0 | 1 | = 1 |
| 3rd " .. | 0 | 1 | 2 | 0 | = 3 |
| 1st pereopod | 1 | 1 | 1 | 0 | = 3 |
| 2nd " | 1 | 1 | 0 | 0 | = 2 |
| 3rd " | 1 | 1 | 0 | 0 | = 2 |
| 4th " | 1 | 1 | 0 | 0 | = 2 |
| 5th " | 1 | 0 | 0 | 0 | = 1 |
| | <hr/> | <hr/> | <hr/> | <hr/> | <hr/> |
| | 5 | + | 5 | + | 3 |
| | | | | + | 1 |
| | | | | | =14 |

The ornamentation of the *pleon* resembles that of the carapace, inasmuch as it varies from being feebly punctate to coarsely reticulate. Inferior lateral margins from the first to the fifth inclusive raised. Posterior lateral border of the second rounded, of the third, fourth, and fifth becoming progressively more angulated from before backwards.

First *pleopod* in the female terminating in two slender pointed processes, above which the appendage is lamelliform and furnished with a fringe of hairs; in the male the endopodite and exopodite are well developed and subequal. The second, third, fourth, and fifth pleopoda in the female are alike, with ovate, foliaceous, hairy exopodites and similar but smaller endopodites, from the base of which on the inner side of each appendage springs a short styliiform process, which, joining with that of the opposite side, yokes the appendages together in the middle line. The third, fourth, and fifth pleopoda of the male resemble those just described, but the second differs in that the endopodite bears on its inner side a widened, hairy, not to say spinous lamina. Between the pleopoda of the fifth abdominal somite there may be a larger or smaller median spine, and between those of the sixth there is a larger hooked process. In the sixth pleopoda the exopodites are broad, foliaceous, and fringed with hairs; the external half of the distal edge of the proximal segment finely spined; the endopodite resembles the exopodite, does not project beyond it, but consists of one lamina, has no spines, and is slightly narrower; the basal segment is furnished

externally with a short process which terminates in a sharp point.

Telson much shorter than lateral portions of tail-fin ; lateral margins converging ; posterior margin slightly convex, furnished with a fringe of hairs and three spines, two lateral and one median, and often some smaller minute spines. Upper surface behind longitudinally scooped out on each side of the middle line, leaving a carina between. The external margins of the grooves are adorned with a curved series of six or seven spines.

Measurement in millimetres of largest specimen.—Total length (from apex of rostrum to end of telson) 117, of carapace (from orbit to posterior margin) 41 ; width of carapace 24, height 27 ; length of rostrum (from hinder edge of orbit to apex) $8\frac{1}{4}$, width 5 ; length of antennular peduncle 15, of antennal scale 18, of peduncle 15 ; 1st pereopod : length of ischio-merus 15, carpus 4, propodus and dactylus 11 ; 3rd, 4th, and 5th pereopoda (measured along external margin) : merus 34, 26, 17, carpus $13\frac{1}{2}$, 11, $10\frac{1}{4}$, propodus 16, 15, 17 ; length of telson 15, of exopodite of tail-fin 20, endopodite 18.

Atya scabra (Leach) is the only American species with which, owing to my having seen specimens of it, I can compare *occidentalis*. In *scabra*, apart from other less noticeable differences, the third pereopods are stouter, more sparsely tuberculated, and the ischio-merus is more sharply angulated above and entirely smooth on the inner surface.

The following species I know only from descriptions :—

Atya rivalis, S. I. Smith, Rep. Peabody Acad. Sci. 1871, p. 94.—Nicaragua.

—— *tenella*, id. ibid —Nicaragua.

—— *punctata*, J. S. Kingsley, Proc. Acad. Nat. Sci. Phil. 1878, p. 94.—Hayti.

But the features pointed out by Mr. Kingsley to distinguish his *punctata* from *occidentalis*, *rivalis*, and *tenella*, not to mention *scabra*, are merely such as in the present paper have been regarded as due either to individual variation or to difference of age.

? *Caridina americana*, Guérin.

Caridina americana, Guérin, Ramon de la Sagra, Cuba Crust. p. 52, pl. ii. fig. 13 ; von Martens, Arch. f. Naturg. 1872, p. 135.

Two females, with ova, taken at Laiou.

These specimens appear to differ from Guérin's figure in exactly the same respects as did the Cuban specimens referred to this species by Dr. von Martens. The femora of the third and fourth pairs of pereopoda, although not conspicuously dilated, are spined beneath, but not so strongly as is represented in the aforesaid figure. Further, in one specimen the rostrum is armed beneath with two spines, in the other with but one. Guérin's specimens appear to have been provided with three.

Family Miersiidae.

Genus XIPHOCARIS.

Xiphocaris, von Martens, Arch. f. Naturg. 1872, p. 139.

As Mr. Kingsley has pointed out (Bull. Essex Inst. xiv. p. 127) the mandible of this genus bears much greater resemblance to that of *Atya* than to that of *Hoplophorus* (or *AcanthePHYRA*); furthermore, since the definition of the group Ephyrinae (= Miersiinae) of this author applies in all respects to the specimens of *Xiphocaris* that I have seen, I have without hesitation referred the genus to this family, although the species of *Miersia* are unknown to me.

The family appears to occupy a position between some such forms as *Caridina* and *AcanthePHYRA*.

Xiphocaris elongata (Guérin).

Hippolyte elongata, Guérin, Ramon de la Sagra, Cuba Crust. p. 20, pl. ii. fig. 10.

Hoplophorus americanus, Saussure, Crust. nouv. des Antilles et du Mexique, p. 56, pl. iv. fig. 31.

Xiphocaris elongata, v. Martens, loc. cit. p. 140.

Ten specimens (females, without ova) were taken at Laiou.

Average length from base of ophthalmopod to apex of telson about 28 millim. The rostrum of this species, as might be expected from its thinness and length, appears to be very liable to damage, seeing that in four specimens out of the ten this weapon is imperfect—in two cases the apex being broken off, in another the anterior half, and in a fourth the anterior two thirds. The teeth vary from 13 to 9 above at the base, 6 to 3 above at the apex, and from 41 to 29 below. In many instances isolated teeth are missing, particularly from the lower series.

Xiphocaris gladiator, sp. n.

Carapace wider behind than in front, slightly carinated above in front, the carina being continued on to the rostrum; proximal half of rostrum bent gradually slightly downwards, distal half bent gradually upwards, but not beyond the plane of the dorsum of the cephalothorax; rostrum extending slightly beyond the antennular peduncle, but not so far as the apex of the antennal scale; armed above proximally with from 12 to 18 minute close-set teeth and with from 2 to 5 also minute and close-set teeth immediately before the apex, and below distally with from 18 to 30 minute close-set teeth. Eyes prominent and pyriform. Basal segment of antennular peduncle furnished with a spine, which is about equal to it in length; second segment about equal to the first in length and distinctly longer than the third; the two flagella smooth, slender, long (but imperfect); peduncle varying in length, in one specimen reaching as far forwards as the front edge of the antennal scale, in two others falling considerably short of it. Antennal peduncle unarmed beneath; scale furnished in front and behind with a fringe of hairs, ovate at the tip, armed with a spine externally. All the pereiopods, sparsely hirsute, are furnished with slender exopods. The first pair shorter but somewhat stouter than the second; ischium stouter but shorter than merus; merus cylindrical; carpus very short, narrower behind; propodus slightly compressed, the stoutest segment in the appendage, its dactylar prolongation armed apically with two or three teeth, which meet with similar teeth on the apex of the curved dactylus. Second pereiopod resembling the first, except that all the segments are longer and more slender; it is longer than the first by its three distal segments. Remaining pereiopods almost alike, being composed of long, slender, cylindrical segments; the merus of each is furnished distally and behind with a single strong spine, the carpus with a few small spines and a distal tooth-like prolongation above, the propodus with two rows of small spines beneath; the dactylus with a strong claw, and, except in the last, three or four strongish spines beneath; the dactylus of the last is furnished with a series of plume-like hairs beneath on its posterior margin. In these appendages the carpus is equal in length to about two thirds of the merus and to half of the propodus and dactylus taken together; the dactylus is about half the length of the carpus.

Branchiæ sixteen on each side, the appendages from the external maxillipede to the fourth pereiopod inclusive being

furnished with one mastigobranch, one arthrobranch, and one pleurobranch, and, in addition, there is one pleurobranch corresponding with the last pereopod.

Pleon hairy at the margins, compressed, rounded and smooth, and neither carinate nor spiny above; sides of the three anterior somites evenly rounded; lateral portion of the fourth somite angularly produced behind, of the fifth likewise produced, but more angularly and more sharply; the sixth somite long, narrower behind, furnished beneath, behind, with a minute median spine; telson shorter than sixth somite, with smooth converging sides and a truncate bifid apex.

Appendages of the pleon hairy, exopodite longer than endopodite, both foliaceous; the exopodites of the first pair long and slender; in the male the endopodite is large and foliaceous, in the female it is small; in the sixth somite the appendages are ovate, large, and foliaceous; the exopodite considerably longer than the endopodite, armed externally with a spine, fringed with hair internally and externally at the distal end; endopodite like the exopodite, but smaller and without a spine.

Three specimens (two females, one with ova, one male) from Laion.

Measurement in millimetres of largest female specimen:—Length from base of ophthalmopod to apex of telson 45, of carapace (above) 12; width of carapace 7; length of rostrum $6\frac{1}{2}$, of eye $3\frac{1}{4}$, of peduncle of antennula $6\frac{3}{4}$, of peduncle of antenna $6\frac{1}{4}$, of antennal scale 9, of external maxillipede 12, of first pereopod $11\frac{1}{2}$, of second 17, of third and fourth 18, of fifth 19, of pleon (including telson) 33; width of pleon $6\frac{1}{2}$; length of sixth somite $7\frac{1}{2}$, width $3\frac{1}{4}$, height $4\frac{1}{2}$; length of telson $6\frac{1}{2}$, of exopodite of tail-fin $9\frac{1}{4}$, of endopodite $2\frac{1}{4}$.

This species may be distinguished from *X. elongata* by its stouter build, smaller eyes, and shorter rostrum.

Var. intermedia, n. var.

Taken with the above was one female specimen which is like them in every respect except as regards the rostrum. This organ is considerably longer, being almost as long as the upper surface of the carapace, projecting upwards at the apex above the plane of the carapace and forwards beyond the anterior margin of the antennal scale. So far as the rostrum is concerned this variety is intermediate between *gladiator* and *elongata*.

Xiphocaris brevirostris, sp. n.

Rostrum bent slightly downwards, projecting anteriorly only as far as the middle of the second segment of the peduncle of the antennula; armed above with nineteen teeth, three of which are just above the apex, and below in its proximal half with sixteen teeth.

Length from base of ophthalmopod to apex of telson 49 millim.

In other respects this species is very like *X. gladiator*, differing from it, however, in being stouter and in possessing relatively smaller eyes; in fact, in exactly the characters which serve to separate *X. gladiator* from *X. elongata*.

Two specimens (one male, one female with ova).

Synopsis of the Species.

- a. Rostrum longer than the cephalothorax *elongata* (Guérin).
- b. Rostrum shorter than the cephalothorax.
 - a¹. Rostrum projecting beyond antennal scale . . } *gladiator*, var. *intermedia*, var. n.
 - b¹. Rostrum not projecting beyond antennal scale.
 - a². Rostrum projecting beyond the proximal end of the distal segment of antennular peduncle *gladiator*, sp. n.
 - b². Rostrum projecting as far as the middle of the second segment of antennular peduncle. *brevirostris*, sp. n.

Whilst examining the above-mentioned specimens of *Xiphocaris* it occurred to me as possible that those that I have regarded as distinct may in reality merely represent stages in the growth of one species.

Apart from the characters presented by the rostrum I think that the differences between the so-called species might be easily explained on the hypothesis of variation with age; for *gladiator*, which is intermediate in size between *brevirostris* and *elongata*, is also intermediate between them in the other respects pointed out, namely the stoutness of the body and the size of ophthalmopods; further, the assumption that the specimens of *elongata* may be young is rendered justifiable by the fact that none of the females are with spawn, whilst some of those of *brevirostris* and *gladiator*, which inhabit the same fresh waters, are laden with it.

I should therefore, were it not for the difference in the

length of the rostrum in the three forms, unhesitatingly regard them as belonging to one species, in which, while passing from the young to the adult condition, the body increases in thickness more than it does in length, and the eye-stalks grow less rapidly than do the other appendages.

But when the rostrum is taken into consideration the problem becomes far more complex. It must be borne in mind, however, that there is a gradation, though not a perfect one, from the long rostrum of the young *elongata*, through *intermedia* and *gladiator*, to the short rostrum of the adult *brevirostris*; but, to the best of my belief, it is contrary to all experience that this organ should progressively decrease in length as the body increases in bulk. Consequently I do not for a moment imagine it likely that the differences are due directly to age. But it seems to me quite possible that in the specimens named *brevirostris*, *gladiator*, and *intermedia* the rostrum at first resembled that of *elongata*, but has been broken off and is reacquiring the form characteristic of that species. In support of this hypothesis may be urged the following considerations:—(1) It may be inferred *à priori* (a) from the armature and length of the rostrum that it is a weapon of offence, and (b) that as such, owing to its thinness, it is exceedingly liable to breakage; (2) from the fact that in 40 per cent. of the specimens of *elongata* obtained this organ is imperfect we know that it is subject to damage, be the cause what it may; (3) the power possessed by the Crustacea of reproducing lost parts is well known; and (4) if the rostrum of the above-mentioned species is undergoing a process of regrowth its present form in each case is exactly what might have been predicted for it; for the shorter rostra are copies in miniature of the longer, the only important difference being the difference of absolute thickness and length. And, further, assuming the specimens to be different species, I would point out that it is a thing of no common occurrence in the Caridea for the teeth to be so constant in position as they are in the present instance, when the rostrum is so variable in size; for in all the specimens of *Xiphocaris*, whether the rostrum be long or short, provided only that its form be perfect, there is a series of teeth in the proximal half above separated by a space from a few teeth at the apex and a series of teeth below running from the apex to the orbit; so that the position presented by these teeth becomes a character of generic significance.

But supposing a specimen of *elongata* had lost the anterior third or anterior half of its rostrum, I presume that when growth set in, this organ would present the appearance seen

in *intermedia* or *gladiator*, and if fractured near the base we should get the short thick rostrum characteristic of *brevirostris*.

However, I by no means wish it to be understood that I bind myself to the theory here propounded; for when attempting to estimate the probabilities of the truth or falsity of it I am compelled to admit that there are many difficulties in the way of its adoption, and that the facts of the case, so far as they are known, are rather in favour of the view of the distinctness of the species named. This view I have consequently chosen, and have put forward the other hypothesis as a possibly plausible explanation of the phenomena presented with the full knowledge that it can only be satisfactorily tested by the careful examination of far more material than is contained in the present collection.

EXPLANATION OF PLATE II.

Fig. 1. Front of *Pseudotelphusa tenuipes*, sp. n. (nat. size, small specimen).

Fig. 1 a. Fourth pereopod of *Pseudotelphusa tenuipes* (nat. size, small specimen).

Fig. 2. Rostrum of *Bithynis appuni* (v. Martens), nat. size.

Fig. 3. *Atya occidentalis* (Newp.), two thirds nat. size of largest specimen.

Fig. 3 a. *Atya occidentalis* (Newp.). Third pereopod of half-sized specimen, nat. size.

Fig. 4. *Caridina americana* (Guér.), $\times 2$.

Fig. 5. *Xiphocaris brevirostris*, sp. n., nat. size.

Fig. 5 a. *Xiphocaris brevirostris*, sp. n. Rostrum.

Fig. 6. *Xiphocaris gladiator*, sp. n. Rostrum.

Fig. 7. *Xiphocaris gladiator*, var. *intermedia*. Rostrum.

Fig. 8. *Xiphocaris elongata* (Guér.). Rostrum.

Note.—In the figures representing the rostra of the several species of *Xiphocaris* the ophthalmopod has been taken as of the same length in each case.

III.—Observations on *Noctiluca miliaris*, Suriray, and the Sea-luminosity produced by it. By Dr. L. PLATE*.

DURING a stay of several weeks upon the island of Borkum in the autumn of 1886 I subjected *Noctiluca miliaris* to a thorough investigation. As, however, our knowledge of this

* 'Zoologische Jahrbucher,' Abtheilung für Anatomie und Ontogenie der Thiere, Band iii. pp. 174–180.

often-observed Cystoflagellate has recently been admirably brought together by Bütschli *, I shall confine myself here to a few brief supplementary notes.

On the nucleus of *Noctiluca miliaris* the statements of different naturalists considerably diverge. Robin (whose latest memoir upon *Noctiluca* I have unfortunately been unable to procure, so that I know his opinions only from Bütschli's statement) and Vignal † regard it as perfectly homogeneous, while Cienkowski ‡ ascribes to its interior substance the faculty of drawing out into threads and cords, which in optical cross-section appear to the observer as globules. According to my observations the nucleus is a vesicle bounded by a distinct membrane, the limpid contents of which are sometimes perfectly homogeneous, *i. e.* uniformly finely granular after the application of reagents; but as a rule there are in the nucleus several nucleoli, which are true globules and by no means represent mere optical cross-sections of plasma-cords. I have never seen nuclei agreeing with Cienkowski's fig. 12, and consequently (without wishing to call in question their occurrence) I regard such nuclei as not of normal structure. The nucleus of *Noctiluca*, as is well known, is imbedded in the so-called central plasma. But that, like the other plasma-granules, it may sometimes be passively moved to and fro over considerable spaces was shown by some individuals in which it lay at a distance from the mouth in a somewhat more densely reticulated portion of the plasma §.

With regard to the so-called "bacillar organ," I quite agree with Bütschli's interpretation, according to which its ridges are produced merely by a particularly close attachment of the plasma to the body-membrane. If we place a *Noctiluca* so that we look from above into the mouth-opening, and at the same time have the tentacle in front of the latter, the bacillar organ, as is well known, takes its origin behind the vestibule in the form of two connivent folds. I believe that a similar formation will also be demonstrated in front of the mouth-opening. To this conclusion I have been led by the observation of *Noctilucae* in course of regeneration. These very frequently show not only three granules projecting more or less above the surface of the body, corresponding to the three ends of the bacillar organ, but also

* Bronn's 'Klassen und Ordnungen,' Band i. Protozoa, neu bearbeitet von O. Bütschli (1885), pp. 1050 *et seqq.*

† Arch. de Physiol. sér. 2, tome v. (1878), p. 436.

‡ Arch. für mikr. Anat. Band ix (1873), p. 49.

§ Confusion with a vacuole is out of the question.

two others, which stand, symmetrically grouped, not far from the tentacle, and which yet certainly owe their origin to the same conditions as the outgrowths formed by the bacillar organ. Unfortunately I omitted to make myself sure of this point upon the living animal. *Noctilucae* in course of regeneration are, in consequence of their contracted plasma, specifically somewhat heavier than the normal individuals; while the latter rise to the surface of the water in a quiet vessel, the former sink to the bottom. Hence, if we examine the bottom-deposit we easily find such five-horned individuals among the animals engaged in regeneration which vary extraordinarily in the length and form of the horns, as well as in the outline of the body.

It is as yet not positively ascertained which of the two modes of reproduction of *Noctiluca* is the more frequent. According to my observations there can be no doubt that in point of number the formation of swarmer exceeds reproduction by simple division. It is only the circumstance that certain stages of the latter process cannot at the first glance be distinguished from conjugation that renders the recognition of the true state of things difficult. I have isolated a great number of biscuit-shaped pairs, and watched them for some time; only a very few of them were engaged in division, while all the rest finally became fused into single individuals. As we meet with such figure-of-eight-shaped *Noctilucae* about as frequently as animals with a swarmer-disk, this gives a considerable preponderance to gemmation over simple division.

On the details of the process of *conjugation* we have already been well informed by Cienkowski. The two pairers are almost always of equal size and are generally middle-sized or small individuals, and as, on the other hand, the *Noctilucae* engaged in the production of swarmer are usually quite full-grown, this circumstance also would indicate that the buds are formed after a conjugation and that their formation is also connected with the latter. It must not be forgotten, however, that in *Noctiluca miliaris* the age of the individuals cannot always be estimated from their size, because the animals too often cast off a part of their membrane* and take on a smaller volume by contraction of the plasma.

The adhesion of the two pairers is effected by means of a

* This observation may be very easily made on animals which have been somewhat disturbed on the object-slide; it appears to me to prove that Bütschli (Morphol. Jahrb. Bd. x. p. 564) is not right in denying to *Noctiluca* any cuticular membrane.

viscous structureless jelly, which is secreted in a thin layer from the part of the body-wall situated above the central plasma. It is remarkable that the nuclei do not now immediately become fused together after the portions of membrane lying between them have been absorbed; at first they rather depart from one another, so that in one of the first stages of the conjugation, when a slender canal of union has been developed between the pairers, the nuclei lie closer together than somewhat later. Thus, while the biscuit-like emargination between the individuals gradually becomes shallower, and the individuals fuse together more and more, the nuclei advance towards each other and finally unite. I have once observed the actual fusion of the nuclei. During this they do not undergo any change of structure, but the newly formed nucleus at first performs small amoeboid movements. The tentacles of the pairers usually disappear at the commencement of the conjugation; they are either cast off, in which case they previously become converted into a wrinkled withered thread, or they are gradually drawn in. Conjugating animals, when kept in the moist chamber, frequently become so much exhausted that they are no longer in a condition to bring the approximated nuclei to amalgamation; they remain alive in this double-nucleate condition for three or four days, and during this period each of them sometimes pushes forth a tentacle.

According to Cienkowski the formation of the swarm-buds is commenced by the rising of two projections of plasma above the surface of the globule. These afterwards divide into four projections, then again into eight, and so on. That such stages with two and four projections do occur is certain, but certainly they do not always occur, for I often found only a thick layer of plasma with a few nuclei, which projected inwards but not outwards. We are indebted to Robin for statements as to the changes which the nucleus passes through in its successive divisions; but such metamorphoses reminding us of the indirect plan only occur during the first divisions; subsequently, as I have frequently observed, it breaks up only by simple constriction.

The development of the cilia does not always occur exactly at the same stage of growth; sometimes they occur very early, when the individual plasmatic outgrowths have still a series of divisions to perform. Then it may also happen that individual buds acquire two flagella. The form of the swarmers is also subject to many variations, as, indeed, was already observed by Cienkowski. The only thing that calls for special notice is the circumstance that the transverse

and longitudinal grooves are often wanting, which would be adverse to the attempt made by Bütschli and Pouchet to demonstrate a Dinoflagelliform structure in the swarmer of *Noctiluca*. In this case they represent ovate or oval corpuseles, somewhat flattened at the side to which the flagellum is attached. The animalcules have no special buccal aperture, which would indicate a short duration for this stage of development.

The fate of the *Noctiluca* which have lost the chief mass of their body in the formation of buds is still unknown. In some animals which had a mature swarmer-disk already furnished with cilia I was still able, by staining, to demonstrate some fragments of nucleus. It is therefore not impossible that some individuals still live on after the liberation of the buds, especially as here and there considerable portions were met with in the thin web of plasma which always remains. The *Noctiluca* kept by me in the moist chamber always perished, because they very easily collapse.

The action of the most different chemical substances and physical forces upon the luminosity of *Noctiluca* has already been tried by a great number of naturalists. They all arrived at the result that the luminosity may be called forth by any strong irritation of whatever nature so long as the air is not excluded. This latter circumstance indicates (as the light is extinguished in nitrogen) that the luminosity belongs to the category of processes of oxidation. It is not difficult to adduce some further observations to prove the correctness of this proposition; thus, for example, the luminosity occurs only in the peripheral plasma of the body, and, further, the regenerative states of *Noctiluca* which accumulate at the bottom of a vessel standing quietly, and which still fully possess their luminous power, are made to phosphoresce with much more difficulty than the normal individuals swimming at the surface, because the latter are in a higher degree under the influence of the atmospheric air. It would therefore be expected that saturation with oxygen gas would call forth the animal phosphorescence with particular intensity, which Quatrefages* disputes. I have therefore repeated this experiment, and in some cases I have succeeded by passing pure oxygen for some minutes in producing a dull light, which was still uninterruptedly visible for about ten minutes after the evolution of the gas. That the experiment sometimes failed was probably due to the primitive conditions under which I had to work.

* 'Comptes Rendus,' tome xxxi. (1850), p. 618.

If *Noctiluca* be laid upon moist blotting-paper and examined under a high power the light radiating from them may be classed under four categories :—

1. Lightning-like, intense luminosity of the whole outer layer, immediately followed by darkness ;

2. The same, but with a faint after-luminosity persisting for one or two minutes ;

3. Dull luminosity of the outer zone of plasma or of some considerable portions of it, with at the same time strong sparkling of particular small points ;

4. A great portion of the surface is entirely or partially luminous, the luminosity being composed of numerous small points.

If we consider the results at which Radziszewski * has arrived it would seem probable that the diffused light of the surface of the body proceeds from the smallest fat-drops of the fine-meshed plasmatic net which occurs throughout immediately beneath the cuticle, while the light consisting of separate points owes its origin to the coarser fat-drops of the peripheral network of sarcode.

The question whether the phosphorescence of *Noctiluca* is or is not a phenomenon subject to the will of the animal has hitherto been but little discussed. I agree with Pouchet †, who says of the luminosity of the Ciliolagellata that "it is a simple physico-chemical property, which appears in the inferior creatures to be independent of the reciprocal vital manifestations of the individuals ;" and I therefore regard the luminosity of *Noctiluca* as an involuntary act, induced by exterior irritation, and from which the animal cannot escape. Thus, if we observe lively *Noctiluca* which are in a perfectly quiet place, we find that there is a complete disappearance of the light. That traces of it now and then recur is probably due to the fact that the *Noctiluca* collected into a dense layer at the surface of the water sometimes disturb one another, or are sometimes irritated by Entomostraca and other small animals, the presence of which cannot be prevented, and are thus brought to luminosity. On the other hand, the phenomenon follows immediately and without exception upon any intense irritation, like thunder after lightning.

Whether and how far the luminosity of the sea, which owes its origin to the cooperation of thousands upon thousands of minute organisms, depends upon the existing conditions of the weather, has, so far as I know, been hitherto but little tested. I therefore, during six weeks on the island of Bor-

* Liebig's Ann. der Chemie, Bd. cciii. (1880), p. 305.

† Journ. Anat. Physiol. tome xix. (1883), p. 437.

kum, observed the wind and weather carefully, with reference to the greater or less intensity of the luminosity of the sea, and arrived at the result that only the wind and the strength of the waves exert any appreciable influence upon the manifestation of that beautiful phenomenon. In order that the phenomenon should present itself in all its splendour the wind must have set persistently for some days from the open sea on to the shore. If this condition coincides with a moderate motion of the surface of the sea the visitor to our North-Sea coast, who very often walks in vain upon the strand in the evening, may reckon with certainty upon the wished-for pleasure. In consequence of the sea-wind great numbers of *Noctiluca* collect in the immediate vicinity of the coast, while the animals are carried away from it by a land-wind. That a strong breaking of the waves does not allow the spectacle to attain its full beauty, notwithstanding the greater irritation to which the animals are subjected, is easily explained by the fact that in this case the *Noctiluca* are drawn down too far beneath the surface of the water, seeing that every particle of a wave describes a curve and descends the deeper in proportion to the height of the wave. I have found nothing to support the widely diffused opinion that the phenomenon is manifested especially in close sultry nights. On several evenings the island of Borkum was surrounded on all sides by thunderstorms, but no trace of luminosity was to be seen in the sea, because a land-wind had prevailed for some time. On the other hand, a high electrical tension of the atmosphere coinciding with a sea-wind gave rise to no particular intensity of the phenomenon. This opinion has consequently found acceptance only because on thundery evenings the sea is usually quiet, and thus favours the manifestation of the luminosity.

IV.—*The Staphylinidæ of Japan.*

By Dr. D. SHARP.

[Continued from vol. ii. p. 464.]

Subfam. *STAPHYLININÆ*.

Group *QUEDIINA*.

Algon grandicollis.

Algon grandicollis, Sharp, Trans. Ent. Soc. Lond. 1874, p. 23.

Miyanoshita, in May; Awomori and Hakodate, in September and October.

There is a second, still more remarkable, species of this genus in my collection, the locality being India.

Velleius setosus, n. sp.

Niger; thorace versicolore, elytrorum margine inflexo testaceo; antennis brevibus, intus biramosis, articulo ultimo brevi.

Long. 17 millim.

This differs conspicuously from the other two species of the genus by the shorter antennæ; these organs have long processes on the inner margins of joints four to ten, as in *V. pectinatus*; but unlike that species the terminal joint is short. The erect setæ of the upper surface are more numerous and conspicuous than in the congeners.

Mr. Lewis procured two examples of this insect at Junsai; I believe they are of the male sex, though there is scarcely anything in the abdominal structure to support this view.

Velleius dilatatus.

Staphylinus dilatatus, Fabr. Mant. Ins. i. p. 220.

Mr. Lewis found this insect at Nikko, Sapporo, and Junsai, thus completely removing all doubt of its being truly a Japanese species. The examples are undoubtedly conspecific with those of Europe. The species of this genus were all associated with the larvæ of *Cossus*.

Quedius præditus, n. sp.

Niger; antennarum apice tarsisque rufis; capite thoraceque nitidissimis; elytris scutelloque fortiter profundeque punctatis; abdomine versicolore, minus crebre punctato.

Long. 12 millim.

Antennæ slender, black at the base, red at the extremity.

This is closely allied to *Q. juno*, but in addition to the different coloration of the legs, palpi, and antennæ it has a remarkably deep coarse punctuation on the elytra.

Miyanoshta, in April and May; Junsai. Six specimens.

I have detected no sexual distinctions among the examples of this species and *Q. juno*; all have the front tarsi much dilated.

Quedius juno.

Quedius juno, Sharp, Trans. Ent. Soc. Lond. 1874, p. 24.

Miyanoshta, Hakone, Nikko, Kiga; rare, generally found under dead leaves, where there was fungal growth.

Quedius abnormalis, n. sp.

Piccus; oculis parvis; prothorace suboblongo, elytris longiore.
Long. 15 millim.

Antennæ obscure red, moderately stout, not thicker externally; penultimate joint as long as broad, as long as the terminal joint. Head suboblong, eyes not in the least prominent and occupying less than one third of the length of the sides, the space behind the eyes numerous punctate. Thorax a little rounded at the sides, hind angles distinct though very obtuse, in front on each side of the middle with three fine serial punctures. Scutellum very obsolete punctate. Elytra deplanate, considerably shorter than the thorax, rather closely and finely punctate. Hind body closely and finely punctate. Legs long.

Found on the borders of the snow at Nikko in June and August; four specimens.

This peculiar insect may be placed in the subgenus *Ediquus*, Rey, as it is related to the European *Q. longicornis*, Kr. I am unacquainted with the male: one of the four individuals before me is considerably smaller than the other three, but does not differ very strongly in any other respect; although it is considerably darker in colour, this is no doubt due to the other examples being somewhat immature.

Quedius flavicornis, n. sp.

Nitidus, niger; clytrorum basi abdominisque segmentis singulis postice rufis; antennis, palpis pedibusque flavis; elytris lævigatis, singulo medio obsolete uniseriatim punctato.
Long. 6 millim.

Antennæ short and stout, clear yellow, sixth to tenth joints transverse. Head narrow, scarcely constricted at the neck; eyes small, occupying not one half of the sides. Thorax quite as broad as the elytra, not so long as broad, narrowed in front, very shining, reddish on the front margin, without serial punctures. Elytra longer than the thorax, shining, black, red at the base, and more indistinctly so along the suture, with three or four very fine punctures placed along the sutural depression and with a similar, still more indistinct series along the middle of each. Hind body not closely punctate, each segment broadly cingulate with red. The male has a feeble emargination on the last ventral plate.

Ichiuchi and Hito-yoshi, at the commencement of May; seven individuals.

This very peculiar species has somewhat the aspect of a *Bolitobius*; it lives under bark of beech trees.

Quedius laticollis, n. sp.

Minus depressus, niger; elytris antennisque rufis, pedibus piceis, tarsis rufis; thorace brevi, elytris multo latiore.

Long. 11 millim.

Antennæ short, red, with the basal joints piceous, sixth to tenth joints transverse, terminal joint acuminate. Head orbiculate, with two punctures on the middle of the front margin; eyes small. Thorax much broader than the elytra, nearly twice as broad as long, much rounded at the sides, without serial punctures. Elytra bright red, shining, rather sparingly and finely punctured. Hind body black, rather closely punctured. Male with an emargination of the last ventral plate preceded by a depression of the surface.

Found on an old tree at Sapporo; a single specimen.

This very remarkable *Quedius* may be placed near *Q. brevis* and *Q. ochripennis*, though not at all closely allied to them; the Japanese species of this genus form a series of remarkably distinct forms.

Quedius hirticornis, n. sp.

Piceus; capite thoraceque fere nigris; elytris, pedibus antennisque rufis, his setis exsertis, perelongatis, ornatis.

Long. 13 millim.

Antennæ rather short, loosely articulated, penultimate joints strongly transverse, all the joints furnished with very elongate conspicuous setæ. Head suborbiculate, eyes small. Thorax broad and short, considerably broader than the elytra. Elytra bright red, finely and rather sparingly punctured. Hind body rather closely and finely punctured, more rufescent at the extremity. Legs short, tibiæ stout, very setose.

A single example of this peculiar *Quedius* was found on an old tree at Mitzusawa, 18th October, 1880; it is a female. The species may be placed near *Q. laticollis*, though very peculiar on account of the setæ of its antennæ and legs.

Quedius imbecillis, n. sp.

Nigro-piceus, nitidus; antennis pedibusque rufis, illis brevibus; abdomine elytrisque parce punctatis; capite utrinque post oculos tripunctato.

Long. 8 millim.

Antennæ short, stouter externally, sixth to tenth joints

transverse. Head small, both short and narrow, only about half as broad as the elytra, on each side behind the eye with three very distinct approximate punctures; palpi yellow. Thorax scarcely so long as broad, piceous. Elytra shining, rather sparingly punctured, a little longer than the thorax; scutellum impunctate. Hind body a little versicolorous, the segments more or less red behind, the anal styles and hind part of the terminal segment rather bright red; sparingly punctate.

Miyanoshita, Dec. 22, 1880; one example.

This insect may be placed near *Q. umbrinus*, though very distinct.

Quedius annectens, n. sp.

Niger, nitidus; antennis, palpis, elytris pedibusque rufis, his tibiis fusciscentibus; elytris ad suturam et ad latera nigro-plagiatis, parce fortiter punctatis.

Long. 8 millim.

Antennæ with the penultimate joints about as long as broad. Head with two punctures on a line in the middle between the eyes. Scutellum not punctate. Elytra a little longer than the thorax, black along the suture, but not quite so far as the hind margin, also with a black mark at each side not extending quite to the base; the punctuation consists of a few distant punctures, which are scarcely serially arranged, and at the sides are finer and more numerous and diffuse. Hind body versicolorous, the terminal segments more or less red towards the extremity; rather closely punctate. The male has a slight emargination of the terminal ventral plate, preceded by a depression of the surface.

Miyanoshita; five examples.

Closely allied to *Q. japonicus*, but with the elytra shorter, differently punctate and coloured.

Quedius adustus, n. sp.

Piceo-rufus, nitidus; capite nigricante, antennis, palpis, pedibus abdominisque segmentorum marginibus rufis; scutello impunctato; elytris abdomineque sat crebre punctatis.

Long. 11 millim.

Antennæ slender, very slightly thicker towards the extremity; penultimate joint rather longer than broad. Head narrow, quite impunctate on the middle. Thorax rounded at the sides and much narrowed in front, on each side of the

middle in front with three large punctures; outside these two other punctures, and still nearer the margin a single puncture. Elytra black, shining, with very definite, not very close punctures, and sparingly pubescent. Hind body rather more sparingly punctate and pubescent. Legs slender, obscure red.

This is nearest to *Q. fulgidus*, but has numerous differences; the antennæ are much more slender, the eyes rather smaller, occupying less than half the length of the sides, the second of the postocular punctures farther from the neck, and the punctuation of the hind body more scanty.

Oyama, Nishi, Nara, Chinzenji, Nishimura, and Numata; scarce.

Quedius multipunctatus, n. sp.

Niger; capite thoraceque subviridescens; elytris læte viridis; antennis, palpis pedibusque rufo-testaceis.

Long. 9 millim.

Antennæ clear yellow, short, scarcely thicker externally; penultimate joints each almost as long as broad. Head sub-orbicular, but a good deal narrower than the thorax, feebly bi-impressed in front, between the eyes with two transverse series of punctures, and with other punctures between the eyes and behind. Thorax about as long as broad, a little narrowed in front, with two series of six or seven punctures each along the middle, and with numerous punctures outside these. Scutellum impunctate. Elytra rather longer than the thorax, of a shining green colour, rather coarsely punctate. Hind body rather closely punctate, the hind margin of the last segment as well as the anal styles yellow.

Hakone.

The example is a female labelled "under bark, rare." I have seen no other. It is an elegant and very distinct species of the subgenus *Raphirus*.

Quedius brevipennis.

Quedius brevipennis, Fairm. Ann. Soc. Ent. Fr. 1859, p. 41.

Nikko, June 1880; one example.

Q. brevipennis is thought by some entomologists to be a brachypterous variety of the variable *Q. boops*, Grav. The example obtained in Japan has the elytra even shorter than they are in specimens found in the Pyrenees.

Quedionuchus planatus, n. sp.

Subdepressus, niger; elytris rufis; antennis fuscis, harum basi, palpis pedibusque testaceis; elytris subopacis, impunctatis.
Long. 9 millim.

Antennæ short and stout, fifth to tenth joints transverse. Head short and broad, rounded behind the eyes. Thorax about as long as broad, with very feeble opalescent reflexions. Elytra rather longer than the thorax. Hind body moderately closely punctate, the hind margins of the segments ferruginous. Hind femora slender, their spines conspicuous. Male with a very feeble emargination on the last ventral plate.

Nikko, August 12th; four specimens.

Allied to *Q. levigatus*, Gyll., but only half the size.

Quedionuchus concolor, n. sp.

Subdepressus, niger, nitidus; antennis pedibusque piecis, tarsis dilutioribus; thorace opalescente; elytris subopacis, impunctatis; femora posteriora sat gracilia.
Long. 10 millim.

Antennæ a little thicker towards the extremity. Head broad and short, much narrowed behind the eyes. Elytra a little longer than the thorax. Hind body sparingly punctate. Male with a slight emargination of the last ventral plate.

Chiuzenji and Nikko; nine specimens.

This differs from *Q. planatus* in numerous minor points besides the colour.

Quedionuchus armipes, n. sp.

Depressus, niger, nitidus; thorace opalescente; antennis pedibusque rufo-piecis; elytris subopacis, punctis paucis setigeris seriatim dispositis; femora posteriora subtus dilatata longiusque spinulosa.
Long. 9 millim.

Antennæ short, fifth to tenth joints transverse. Head transverse, straight behind the eyes, which are not prominent. Thorax subquadrate, the angles less rounded than in the allied species. Elytra with a few wrinkles, a series of five or six setigerous punctures near the suture, a similar series near the outside, and one or two punctures between the series. Hind body rather broad and flat, moderately closely punc-

tate, the hind margins of the segments red, terminal segment broadly red behind. Tarsi short.

Shimidzu, Yuyama, Nikko ; four specimens.

Although bearing much resemblance to the Austro-Malayan species of *Belonuchus*, this is a true *Quedionuchus*. The remarkable armature of the hind legs is very like that of the Central-American *Q. femoralis*.

I do not see any characters to distinguish the male.

Heterothops rotundiceps, n. sp.

Nigro-piceus, nitidus, antennarum basi dilutiore, pedibus testaceis ; capite suborbiculato, oculis magnis ; elytris thorace brevioribus. Long. 5 millim.

Antennæ short, not thicker externally, three basal joints piceous, the others dark ; fifth to tenth joints differing very little from one another, each nearly quadrate. Eyes very large, extending nearly all the length of the sides. Thorax rather short, not quite so long as broad, a little narrowed in front. Elytra shorter than the thorax, unicolorous, not densely punctate. Hind body moderately closely punctate.

Nikko, Kiga ; two specimens.

This little insect has the appearance of a small *Quedius* of the *Raphirus* group, due no doubt to its large convex eyes.

Group STAPHYLININA.

Philonthus addendus, var.

Philonthus addendus, Sharp, Trans. Ent. Soc. Lond. 3rd ser. v. p. 440.

Two examples have been met with at Nikko, one in June 1880 another in July 1881, which do not differ apparently by any good character from European examples, although they do not agree quite satisfactorily therewith in all their details and differ a little from one another. More information must therefore be obtained before we can decide positively about these examples.

Philonthus cyanipennis.

Staphylinus cyanipennis, Fabr. Ent. Syst. i. p. 525.

Common in fungi in Japan. The specimens differ a little from those found in Europe, the thorax being more oblong, with less rounded hind angles.

Philonthus bicaudus, n. sp. (Group 4, Erichson.)

Niger; capite, thorace elytrisque nigro-subaeneis; capite ovato; elytris abdomineque crebrius punctatis.
Long. 14 millim.

Antennæ rather slender, not thicker externally, tenth joint quite as long as broad. Head narrow, only about half as broad as the elytra. Thorax much narrowed in front; elytra and scutellum closely punctate; hind body rather closely punctate.

Only a single individual has been found—an immature female—but the species is so distinct that it will not be mistaken for any other; it resembles the species of the European *P. politus* group, but has a different structure of the front tarsi; these are (in the female) much dilated, and the apical joint is broad and deplanate and closely spinose beneath; the median lobe of the armature is remarkable on account of being divided into two long slender styles.

Found at Niigata on the 12th September, 1881.

Philonthus liopterus, n. sp. (Group 4, Erichson.)

Latiusculus, nitidior, parce punctatus, piceus; capite nigro; antennis pedibusque rufis.
Long. 9 millim.

Antennæ rather short and stout, but the basal joints rather elongate, the four or five penultimate joints strongly transverse. Head extremely shining, suborbiculate, with only a few coarse punctures. Thorax rather short, subquadrate, straight at the sides, piceous, very shining, the punctures of the dorsal series rather large. Elytra rather longer than the thorax, piceous black, very shining, quite sparingly punctured. Hind body also sparsely punctate, shining. Legs red, tibiæ infuscate; middle coxæ moderately distant. The male front tarsi broadly dilated, apical ventral plate with a broad shallow excision.

A single example of this very distinct species was met with at Junsai, in Yezo.

Philonthus micanticollis, n. sp. (Group 4, Erichson.)

Niger, fusco-pubescent; elytris aeneis; thorace sericeo-micante, pedibus testaceis, tibiis infuscatis, antennarum basi palpisque

fusco-testaceis; antennis gracilibus; elytris abdomineque crebrius punctatis.

Long. $7\frac{1}{2}$ millim.

Antennæ slender, not thicker externally, the penultimate joint evidently longer than broad, the basal joint yellowish behind, the terminal joint scarcely paler than those preceding it. Head rather small, almost circular. Thorax not elongate, subquadrate, scarcely perceptibly narrowed in front, the four punctures of the dorsal series moderately large, the surface very shining and in a certain light exhibiting a strong sericeous reflexion. Elytra of a dilute brassy colour, longer than the thorax, rather closely and finely punctate. Hind body densely punctate, with some coarser punctures across the base of the three basal segments. Legs pale yellow, the tibiæ infusate internally. Middle coxæ moderately distant. Front tarsi of the male distinctly but not greatly dilated; last ventral plate with a small, rather deep excision.

This is not closely allied to any other Japanese species; but I have a very similar one from China. It comes nearer to the description of *P. albilabris* than any other I know.

A single example was found at Nagasaki on the 3rd March, 1881.

Philonthus depressipennis, n. sp. (Group 4, Erichson.)

Depressus, nigricans; elytris æneis; antennis fuscis, basi palpis pedibusque testaceis; capite majore, prothorace posterius angustato, linea marginali anterieus valde subtus inflexa; elytris abdomineque parce punctatis.

Long. 7 millim.

Head large, subquadrate, with numerous coarse punctures about the sides, eyes small. Antennæ moderately long, not stout, the penultimate joint not quite so long as broad, the two basal joints yellow. Thorax much narrowed behind. Elytra and scutellum sparingly punctate. Legs yellow, with the tibiæ rather more obscure, the tarsi short, the basal joint of the posterior shorter than the apical; the middle coxæ moderately separated.

Three examples have been found, two at Ichiuchi on the 1st of May and one at Konosè on the 17th of the same month.

This is an abnormal species, with the thoracic lateral line greatly deflexed, so that the longer tactile seta is remote from it. The front tarsi are simple probably in the two sexes, as from a difference in the size of the head I believe I have both before me.

Philonthus discrepens, n. sp. (Group 5, Erichson.)

Sat latus, niger; elytris saturate rufis, pedibus testaceis; antennis fuscis, basi apiceque sordide rufis; elytris abdomineque crebre punctatis.

Long. 8-9 millim.

Antennæ rather slender, dark in the middle, obscurely ferruginous at the extremity and sordid yellow at the base; penultimate joint as long as broad; palpi sordid yellow. Head moderately large, suborbiculate. Thorax shining black, a little narrowed in front. Elytra pale red, not closely punctate, shining. Hind body blackish, with faint metallic reflexions; hind margins of the segments above obscurely, below distinctly red, moderately closely punctate. Legs clear yellow, the coxæ fuscous; the middle pair a little separated.

In the female the front tarsi are a little and in the male a good deal dilated; in the latter sex there is a deep excision on the last ventral plate.

This is a distinct species, having the anterior puncture of the dorsal series more distant from the front margin than usual.

Five examples were found at Nikko, June 1880.

Philonthus erythropus.

Philonthus erythropus, Kr. Wieg. Arch. 1859, i. p. 88.

One example.

Philonthus virgatus, n. sp. (Group 5, Erichson.)

Angustulus, niger, pedibus testaceis; elytris vittis magnis duabus posterius conjunctis, testaceis; antennis fusco-rufis, tenuibus; abdomine densissime subtilissimeque punctato, segmento singulo margine posteriore ferrugineo.

Long. 8 millim.

Antennæ quite slender, the penultimate joints a little shorter, more slender and paler than those in the middle, the tenth evidently longer than broad; palpi pale fuscous. Head rather small, suborbiculate. Thorax shining black, a little narrowed in front, the punctures of the dorsal series rather large. Elytra not longer than the thorax, rather sparingly punctate, the base and outer margin black, the inner portion yellow, but divided by a longitudinal black mark not reaching the hind margin, the extreme edge of the

inflexed side margin yellow; the middle coxæ are nearly contiguous.

This is a very distinct species: five examples have been met with; they all have the front feet moderately dilated, their sex being uncertain; those examined beneath are apparently males, but have no notch on the last ventral plate.

Nikko, Chiuzenji, 22nd August, 1881.

Philonthus angustatus.

Philonthus angustatus, Kr. Wieg. Arch. 1859, i. p. 92.

This is perhaps not sufficiently distinct from *P. thermarum*, Aubé, though Fauvel's statement (Faune G. R. iii. p. 471) that the differences pointed out by Kraatz are absolutely illusory is at least exaggerated; I have not, however, seen sufficient examples to bring me to a positive conclusion on the matter.

Mr. Lewis met with an example at Nagasaki on the 28th May, 1881, and the individual from Northern China mentioned by me in speaking of *P. thermarum* (Trans. Ent. Soc. 1874, p. 44) is also to be referred to *P. angustatus*.

Philonthus sulcifrons, n. sp. (Group 5, Erichson.)

Minutus, niger, nitidulus; antennarum basi pedibusque testaceis; elytris pallidis, basi fuscis; capite oblongo, antè impresso profundeque canaliculato; elytris parce punctatis, prothorace paulo longioribus.

Long. 4 millim.

This is the insect alluded to by me (Trans. Ent. Soc. 1874, p. 44) as possibly a variety of *P. thermarum*; but Mr. Lewis has now brought back a small series from which it would appear more probably to be distinct, the remarkable depression and channel on the front of the head being characteristic; it is also of darker colour, rather larger and broader, with stouter, differently coloured antennæ.

I have seen from various sources ten examples, six of which were captured by Mr. Lewis at Nagasaki on the 22nd February, 1881.

Philonthus pygmaeus.

Philonthus pygmaeus, Kr. Wieg. Arch. 1859, i. p. 93.

This is regarded by Fauvel (*l. sup. cit.*) as the same as *P. thermarum*, but appears to me more probably distinct.

Mr. Lewis met with a specimen at Kioto on the 4th July, 1881, differing from a Ceylonese example only in possessing a slight depression on the front of the head.

Philonthus debilis.

Staphylinus debilis, Grav. Col. Micr. p. 35.

Yokohama, Shirvi, Iwaki, Hakodate.

Philonthus nigrutilus.

Staphylinus nigrutilus, Grav. Col. Micr. p. 41.

The Japanese individuals of this widely distributed and variable species are far from agreeing exactly with our European varieties; they are remarkably elongate, with narrow head, slender oblong thorax, which is not narrowed in front, and brassy elytra; amongst the small series before me there are, however, some individuals which indicate that there will prove to be more than one variety or form in Japan.

Nagasaki, Miyanoshita.

Philonthus inconstans, n. sp. (Group 6, Erichson.)

Fuscus, capite nigricante, thorace rufo-piceo; antennis testaceis, basi pedibusque flavis; thorace oblongo, seriebus dorsalibus obsolete 5- vel 6-punctatis; elytris hoc fere brevioribus; abdomine crassiusculo, dense subtilissime punctato.

Long. $4\frac{1}{2}$ – $5\frac{1}{2}$ millim.

This species belongs to the subgenus *Rabigus*, Rey, and is allied to the European *P. tenuis*; but it is smaller, of a different colour, and has the antennæ yellow. Unlike the European species, it is extremely variable. Sometimes the thorax and head are of one piceous black colour, sometimes the head is quite black and the thorax bright red, and sometimes the elytra are obscure red; the elytra are sometimes much shorter than the thorax, but in some cases are about equal to them in length; the number of punctures in the dorsal series is apparently as often five as six. The fine pubescence on the hind body is somewhat flavescent in colour. The front tarsi of the male are only moderately dilated, and the last ventral plate has a broad shallow emargination preceded by a triangular membrane.

Found in several localities, but apparently rare. Osaka, Niigata, Yokohama, Oyama, Hakodate, Junsai.

Philonthus cunctator, n. sp. (Group 6, Erichson.)

Angustulus, niger, elytris æneis, antennarum basi apiceque pedibusque testaceis, abdominis segmentorum marginibus posterioribus ferrugineis; capite anguste ovato; elytris abdomineque dense punctatis.

Long. 8 millim.

Antennæ elongate, very slender, fuscous, with the two basal joints and the apical joint yellow; palpi yellow. Head very narrow, only half as broad as the thorax; this latter elongate, narrowed in front, the punctures of the dorsal series rather fine. Elytra closely and finely punctate. Hind body with the hind margins of the segments reddish, those at the base only narrowly so, those at the extremity broadly; terminal styles elongate, their extreme base and the median lobes red. Legs clear yellow, middle coxæ contiguous; male with the anterior tarsi slightly dilated and an extremely slight excision of the last ventral segment.

This species is allied to *P. fumarius*, though abundantly distinct by a number of characters.

A single example was met with at Yokohama on the 27th October, 1881.

Philonthus spadiceus, n. sp. (Group 7, Erichson.)

Elongatus, depressus, nigerrimus; antennis palpisque piceis, illis gracilibus, elongatis; elytris abdomineque crebrius punctatis, illis sat nitidis.

Long. 10–11 millim.

Antennæ rather longer than head and thorax, not thicker externally, quite slender, the penultimate joint much longer than broad. Head suboblong, densely punctate at the vertex and the sides of the eyes. Thorax elongate and slender, nearly parallel-sided, with a dorsal series of eight rather large punctures, this series more or less irregular, and frequently with one or two additional punctures intercalated. Elytra quite black, flat, very finely pubescent, finely punctate, a little shining. Hind body densely punctate. Femora picescent; middle coxæ rather narrowly separated; front tarsi of female a little, of male much, dilated; the latter sex with a rather broad, not deep, emargination on the last ventral plate.

This is allied to *P. prolatus*, but is readily distinguished by the longer and more slender antennæ, by the deeper black colour, longer and flatter elytra with less conspicuous pubescence, and by the additional puncture in the thoracic

series, this latter character being, however, not easily observed on account of the great irregularity of the series. The fact that the male tarsi are only about half as broad as they are in *P. prolatus* differentiates the species with certainty.

Rare, Kawasaki near Yokohama, Awomori, and Sapporo.

Philonthus macrocephalus, n. sp. (Group 7, Erichson.)

Depressus, niger; elytris rufis; antennarum apice, palpis, tibiis tarsisque rufescentibus; capite majore, fortiter disperse punctato; prothorace haud elongato, basin versus angustato, seriebus dorsalibus irregularibus circiter 8-punctatis; elytris abdomineque crebre punctatis.

Long. 13 millim.

Antennæ not elongate nor stout, blackish, becoming obscurely red towards the extremity; penultimate joint evidently shorter than broad. Head flat, subquadrate, with numerous coarse distant punctures, but with a broad space along the middle impunctate; underside impunctate. Thorax not so large as the head, anterior angles well marked, the discoidal series consisting of coarse punctures, placed more or less irregularly and varying in number from seven to nine. Elytra, scutellum, and hind body somewhat coarsely and closely punctate.

I am not able to point out any sexual characters; the front tarsi are slightly dilated, no doubt in each sex.

This species has the upper marginal line of the thorax greatly deflexed in front, so that the longer tactile seta is remote from it; this will ultimately require its removal from *Philonthus*. It has the aspect of a *Belonuchus*, but cannot be placed in that genus because of its unarmed femora and (slightly) dilated front feet.

A small series was found at Ichiuchi and Yuyama in May 1881.

Philonthus daimio, n. sp. (Group 8, Erichson.)

Niger; capite thoraceque nigro-subæneis; elytris fusco-æneis, abdomine subversicolore breviter flavo-pubescente; pedibus testaceis, tibiis plus minusve fusciscentibus; capite thoraceque crebrius punctatis, hoc area longitudinali lævigata; elytris abdominequo dense punctatis.

Long. 9-11 millim.

Antennæ blackish, slender, each joint longer than broad. Head very numerously punctured, the punctures more scanty towards the middle, where there is a small glabrous space.

Thorax a little narrowed towards the front, with very numerous coarse punctures, leaving an irregular space along the middle smooth. Elytra and hind body closely and rather finely punctate.

Allied to *P. gastralis*, but with numerous differences in colour, punctuation, and size; the female has the front tarsi distinctly dilated, the male I do not know.

Two examples found at Otaru and one at Hakodate.

HESPERUS.

To this genus, recently established by Fauvel, I have to add an elegant Japanese species, as well as *Philonthus tiro*, previously described by me; this latter is rather aberrant, the form being elongate and *Philonthus*-like and the middle coxæ less widely separated.

Hesperus ornatus, n. sp.

Niger; antennarum apice tibiisque rufis; abdomine apicem versus rufescente; elytris rufis, ante apicem nigris, apice ipso albido-marginato.

Long. 11 millim.

Antennæ only moderately long, black, with the three terminal joints white; palpi elongate, piceous. Head shining black, coarsely punctate at the sides, a broad space on the middle smooth. Thorax oblong, shining black, coarsely punctate, with a straight, rather narrow space along the middle smooth. Elytra closely and not quite finely punctate, somewhat shining. Hind body rather sparingly punctate, black, with slight particoloured reflexions, the two terminal segments red. Legs slender, coxæ and femora piceous or nearly black, tibiæ white, fuscous at their extremity, tarsi yellowish. The male has a well-marked notch on the last ventral plate, and its front tarsi are a little dilated; in the female these feet are only very slightly dilated.

Rare, Hiitoyoshi, Yuyama, and Nikko, in the month of May, under dead leaves with fungal growth.

Actobius inornatus, n. sp.

Angustulus, elongatus, subdepressus, niger; antennis fuscis, basi pedibusque testaceis.

Long. 5 millim.

Antennæ rather slender, but little thickened externally,

the penultimate joints scarcely transverse. Head coarsely and closely punctate, with only a small space on the disk glabrous. Thorax long and narrow, punctured like the head, with a broad, definite, longitudinal space smooth. Elytra elongate and narrow, rather closely and coarsely punctate, black, only the hind margin indefinitely fusco-testaceous.

A single example was found at Yokohama, 7th April, 1880.

Cafius rufescens, n. sp.

Rufo-brunneus; capite thoraceque nigricantibus; antennis rufis, pedibus fusco-testaceis, cinereo-pubescentibus, opacis; capite thoraceque dense, fortiter profundeque punctatis, linea longitudinali lata, arguta, glabra.

Long. 5 millim.

This species is allied to the European *Philonthus sericeus*, auct., but is distinguished by the colour and other characters apparently subject to but little variation. The head and thorax are much more deeply and coarsely punctate, and the glabrous line on these parts is broader, definite, and more shining, the antennæ are shorter, and the punctuation of the elytra and hind body is not quite so dense and fine. From *P. algarum* it is distinguished by the colour, the much less slender form, and much shorter and thicker antennæ. The male is distinguished by the possession of a setigerous pore on each of the second and third ventral plates and by a large excision of the terminal plate. The setigerous pores do not exist in the corresponding sex of the allied species.

Yokohama, Niigata, Hakodate, under seaweed, probably generally distributed in suitable localities on the coast. I have a specimen from Hong Kong in my collection.

[To be continued.]

V.—*Ophiopteron elegans*, a new, probably *Natatory*, Form of *Ophiurid*. By Dr. HUBERT LUDWIG*.

AMONG the Holothuriæ which Dr. J. Brock collected during his travels in the Indian Archipelago and entrusted to me to be worked up there was a single example of an Ophiuran

* Translated from the 'Zeitschrift für wissenschaftliche Zoologie,' Bd. xlvii. pp. 459-464 (with a plate).

collected near Amboyna which, on close examination, appeared to be a very remarkable new form. The most striking thing about it is the circumstance that each joint of the arms bears a pair of large fins, which could hardly have any other purpose than to confer upon the animal the power of natatory locomotion.

Description of the specimen.—The disk has a diameter of 6 millim. Each of the five arms measures about 30 millim. from the margin of the disk to its apex. The colour is a uniform light greyish yellow or yellowish white; only on the ventral surface of the disk the coloration in the interradial is darker, from brownish yellowish to greyish violet.

The arms at their base are 5.5 millim. broad, including the fins, without the fins scarcely 1.5 millim. The dorsal and ventral scutes have the same breadth of 0.75 millim. The ventral scutes in the region of the disk are somewhat broader than long and scarcely narrower at their proximal than at their distal margin; the latter is slightly emarginate, while the lateral margins show a deeper emargination; orally from the lateral emargination a short oblique line indicates the point of junction of the ventral scute with the lateral scute; the angles which unite the lateral with the distal margin are rounded off. In the middle of the length of the arm the ventral scutes are considerably narrower at their proximal than at their distal margin, the lateral emarginations are no longer distinct, but, on the other hand, the oblique lines of junction of the ventral scutes with the lateral scutes have become comparatively longer. The dorsal scutes in the middle division of the arm have on the whole a rounded rhombic form; their greatest breadth is nearer to their distal than to their proximal end; the two distal sides of the rhombic form pass into each other in a more broadly rounded fashion, the two lateral angles are also rounded off, while the proximal angle is transversely truncated; the median portion of the dorsal scute is somewhat more convex than the lateral parts, so that a broad but rather low longitudinal keel is produced upon the middle of the back of the arm. The lateral scutes form upon each side of the arm a high band or plate, which commences on the ventral surface of the arm at the insertion of the tentacular scale hereafter to be mentioned, and, ascending to the dorsal surface in a curved line, extends to the proximal part of the lateral margin of the dorsal scutes; this band serves for the insertion of the brachial spines.

The hyaline brachial spines occur in three different forms:—1, as hooks; 2, as spinulose spines; 3, as the supporting rods of the fins. Starting from the dorsal surface of the arm each

lateral scute bears in the first place near the tentacular scale a hook; then follows a spinulose spine, and beyond this begins the fin, into the composition of which (in the lower and middle parts of the arm) there enter ten bacilliform spines. The hooks possess four buccally directed, curved points, which stand in a row one below the other; towards the apex of the arm the number of points diminishes to three and finally to two. The spinulose spines are about half as long again as the hooks, but, like these, stand off obliquely from the arm and have the form of a club beset with spines in its outer half; the basal portion of the club shows an enlargement for articulation upon the band of the lateral scute. The supporting rods of the fin are also attached by an enlarged base; but above this they rather quickly diminish into a thin rod, which gradually becomes thinner and traverses the fin to its free lateral margin, following a slightly curved course. The supporting rods usually do not terminate in a simple point, but fork a little before their termination, so that the two branches of the fork lie close together. The reticulate structure of the calcareous bodies of the Echinodermata is well developed in the thickened base of the supporting rods, but is deficient in their middle part, although it is indicated in the terminal section by fine, oblique, transverse canals. If we distinguish the supporting rods by consecutive numbers, starting from the ventral surface of the arm, there is a slight increase of length from 1 to 3 and a diminution from 4 to 10; 5 is of about the same length as 1, while 10 is only half as long.

The fin is formed by a thin transparent membrane, in which we can distinguish an inner margin attached to the band of the lateral scute, a free anterior margin directed towards the tip of the arm, a free outer margin, and a free posterior margin turned towards the base of the arm. The course of the line of insertion of the fin upon the lateral scute causes the anterior margin to originate on the ventral surface and the posterior margin on the dorsal surface of the arm. As the whole fin from the anterior to the posterior margin has a greater extent than the length of an arm-joint, the consecutive fins lie over one another like tiles, so that in looking at the arm from the back the aboral portion of each fin is overlain by the adoral part of the next one. The anterior and posterior margins of the fin are not formed by the first and last supporting rods, but by a narrow border of the fin-membrane, which runs along the rods in question. At the free outer margin the fin-membrane passes in curves from the tip of one supporting rod to that of the next.

In the basal part of the arm the fins show some variations. In the first place, on the first three free arm-joints (*i. e.* those not entering into the disk) the two fins which belong to each arm-joint are not separated from each other, but are united into one on the dorsal surface by fusion of their hinder margins. In the second place, on the (four) arm-joints situated within the disk the fins behave otherwise than on the free arm. The first of these joints, that lying nearest to the mouth, bears on each side only two small spinules, which in their position correspond with the hooks and spinulose spines; the first arm-joint also is destitute of the tentacular scale. From the second arm-joint onwards the tentacular scale is present; the second joint further possesses on each side a distinct hook, a spinulose spine, and, instead of the fin, a smooth spine. On the third arm-joint there is on each side the hook, the spinulose spine, and two or three smooth spines united by swimming-membranes. On the fourth joint the fin-structure is already complete.

The feet, as in many other Ophiurans, are beset with small warts on their surface; the buccal feet also show the same character.

No less worthy of notice than the fins of the arms are the peculiar structures into which the dorsal spines of the disk have been developed. If the disk be examined from above under a low power, it is seen to be covered with a delicate, close, satiny down, which, on closer examination, proves to consist of a number of fine, generally hexagonal, funnels. Each funnel consists of a short thick spine, which at its outer end is continued into six comparatively long fine spines of unequal length, so united to each other by a thin membrane that a funnel is produced, the delicate membranous wall of which is supported by the six fine spines. Sometimes, however, only five such supporting spines are present. The thick stalk of the funnel is articulated upon a dense but very fine calcareous reticular tissue, lying in the dorsal skin of the disk. The dorsal skin of the disk further contains very thin radial scutes, of which, in the uninjured disk, only the distal points are uncovered by the funnels; so that it is only when the latter are removed that it is seen that the thin radial scutes are of a rounded triangular form and joined together in pairs by their longest sides.

On the thin, soft, translucent skin of the ventral surface of the disk the funnels are wanting, and, indeed, at the periphery of the dorsal skin they separate from each other and become less numerous in the direction of the interradii. In place of them we find in the ventral skin scattered, rather distant,

minute, circular, latticed plates, in the middle of which rises a short spinule, which bears at its free extremity several parallel points but no funnel.

The peristome is 3 millim. in diameter and is constructed in a manner which at once reminds one of the genera *Ophiothrix* and *Ophiogymna*. Buccal papillæ are entirely wanting. The dental papillæ stand externally in three, and further inwards in two rows one over the other; whether these are followed further in by some true teeth (*i. e.* papillæ standing in a row one above the other) I could not ascertain without damaging the specimen too much. The corner-pieces of the mouth leave between them a gap widening aborally in the middle line of each interradius. The lateral buccal scutes are slightly curved, narrow, broader at the adradial than at the abradial end, and do not touch each other. The buccal scutes are broader than long, rhomboidal, with rounded angles and slightly emarginate sides; the aboral angle is much more broadly rounded off than the adoral. The broad buccal fissures are directly contiguous to the outer sides of the buccal scutes, and are separated only by a narrow interspace at the outer angles of the latter*.

Systematic Position.—The above-described fins are perfectly characteristic of the present form, and as we know of no similar arrangement in any other species of Ophiurid, it seems justifiable to establish a new genus under the name of *Ophiopteron*. But if we leave the fins out of consideration, and only look at the other characters, our new form appears to be most nearly related to the genus *Ophiothrix*. In favour of this relationship we have not only the structure of the peristome, but also the rest of the formation of the disk, as well as, in an equal degree, the structure of the arms. The peristome of *Ophiopteron* presents the same characters as in *Ophiothrix*—the absence of buccal papillæ, gaps between the buccal corner-pieces, and transverse buccal scutes not projecting into the interbrachial regions. The radial scutes also agree in form and position with those of *Ophiothrix*. The peculiar funnel-shaped spinosity of the back of the disk, so far as it consists of calcareous tissue, is present in several species of *Ophiothrix*; but the latter do not possess the fine

* After the above description was written I received from Dr. Brock a second, but unfortunately very badly preserved specimen, the arms of which are as much as 36 millim. long, while the disk has the same diameter as in the specimen above described. In this second example the colour of the disk is light greenish and the arms show indications of pale green transverse bands. It is particularly remarkable that the fins are so torn and damaged that at the first glance one can hardly recognize the animal.

membrane which forms the wall of the funnel; in connexion with this the figures which Lyman has given* of the dorsal spines of several species of *Ophiothrix* may be consulted. In the arms the agreement with *Ophiothrix* lies in the form of the ventral and dorsal scutes, the singleness of the tentacular scales, the glassy texture of the divergent spines, of which the single (free) spine, as in *Ophiothrix*, is spinulose on the sides and at the apex, and, lastly, in possession of the hooks, which are also present in *Ophiothrix*.

Finally, attention may be called to the resemblance which the fin-formation in *Ophiopteron* presents to that of the Pterasteridæ. As in those starfishes, it is precisely the lateral scutes which are homologous with the adambulacral plates, the spines of which in the Ophiuran before us become united by a swimming-membrane to form a fin.

VI.—*Descriptions of a new Genus and some new Species of Cicadidæ belonging to the Oriental Region.* By W. L. DISTANT.

THE following descriptions are the result of an examination of the collection of Oriental Cicadidæ in the Leyden Museum, for which I am indebted to the kindness of Dr. Ritsema, of a small but extraordinary novel collection made in Karwar and forwarded to me by E. T. Atkinson, Esq., and of another small collection received from the southern slopes of the Nilgiris and made by my ever helpful friend G. F. Hampson, Esq. All these species will be subsequently figured.

Gæana Atkinsoni, n. sp.

Head and thorax above black; eyes and a transverse fascia between them, posterior margin of pronotum, two linear obconical spots on disk at anterior margin of mesonotum and its lateral margins, and the cruciform elevation ochraceous; abdomen above and below ochraceous. Head beneath, sternum, and legs black; apical half of face, a transverse spot between face and eyes, and disk and margins of sternum

* "Ophiuridæ and Astrophytidæ, new and old," in Bull. Mus. Comp. Zool. Camb., Mass., vol. iii. no. 10 (1874), pl. iii. figs. 19, 21-25, pl. iv. fig. 25.

ochraceous. Opercula black, their base and outer margin ochraceous.

Tegmina black, the venation, a narrow, oblique, transverse fascia near base, and a straight and wider transverse fascia near centre completely crossing the tegmina ochraceous; two subapical spots and a similar spot in the sixth apical area reddish ochraceous. Wings bright carmine-red, apical and outer margins and a subapical transverse fasciate spot black.

The rostrum reaches the posterior coxæ, the anterior femora are armed with two strong spines, and the body is large and robust.

Long. excl. tegm., ♂ 35 millim., exp. tegm. 85 millim.

Hab. Continental India, Karwar (*Atkinson*).

Gæana Hageni, n. sp.

Body olivaceous brown. Head with the lateral margins of front, pronotum with two oblique, irregular, linear spots on each lateral area, and a small central spot at base blackish. Mesonotum with two central, obconical, castaneous spots at anterior margin.

Tegmina pale greenish, the costal membrane, a somewhat broad apical margin irregularly waved internally, a rounded spot at base of third apical area, and the apical half of inner margin (narrowly) dark brownish. Wings pale bluish green, the apical and outer margins not reaching base, narrowly dark brownish.

Rostrum not quite reaching the posterior coxæ. Face large and tumid, the transverse striations coarse and prominent, central sulcation only prominent at about centre.

Var. *a*. Tegmina with two dark brownish spots, one at base of third apical area and another, smaller, at base of fifth apical area.

Long. excl. tegm., ♂ 32 millim., exp. tegm. 82 millim.

Hab. Sumatra, Tandjong, Morawa, Serdang (*Dr. B. Hagen*). Leyden Mus.

Leptopsaltria nigrescens, n. sp.

Brownish ochraceous, with the following black markings:—Head with the area of the ocelli, the inner margins of the eyes, a spot near bases of antennæ, a spot on each side of front, and a central transverse linear line at base; pronotum with two central lines united at base and the incisures; mesonotum with two central obconical spots at anterior margin, a sub-lateral fascia on each side, and a spot in front of each anterior angle of the basal cruciform elevation; the posterior

margins of the abdominal segments, the margins of the eyes beneath, the apex of the face, the disk of the sternum, the inner halves of the opercula, the abdominal tubercles, and the disk of abdomen.

Tegmina pale hyaline, the basal venation brownish, the apical venation fuscous. Wings pale hyaline.

The rostrum passes the posterior coxæ, the opercula are concave externally, oblique internally, the apices narrowed and angularly rounded.

Long. excl. tegm., ♂ 20 millim., exp. tegm. 56 millim.

Hab. Java (*Van Lansberg*). Leyden Mus.

Dundubia emanatura, n. sp.

♂. Pronotum above either greenish or ochraceous. Abdomen ochraceous. Head with a narrow, reticulated, linear, transverse, black fascia between the eyes enclosing the ocelli and a black spot at anterior lateral angles of vertex; eyes brownish; pronotum with a narrow, black, lateral marginal fascia; body beneath and legs ochraceous, apices of posterior tibiæ infuscated.

Tegmina and wings pale hyaline, the venation pale greenish ochraceous.

The rostrum reaches the intermediate coxæ; the opercula are very narrow, slightly curved outwardly, concave on each side near base, the apex broadly convex and extending to about half the length of the abdomen.

♀. Abdomen with a lateral marginal black fascia on each side.

Long. excl. tegm., ♂ 26 millim., exp. tegm. 72 millim.

Hab. Continental India, Karwar (*Atkinson*); Nilgiris, southern slopes, 3000 feet (*Hampson*).

Dundubia amicta, n. sp.

Allied to *D. majuscula*, Dist., from which it differs by the pronotum having a black sublateral margin, different markings of the mesonotum, which consist of a central longitudinal fascia crossing disk, on each side of which is a shorter oblique fascia, a broad sublateral fascia on each side, and a spot in front of each anterior angle of the cruciform elevation; the tibiæ blackish. Tegmina unspotted, none of the transverse veins infuscated. The opercula are very distinct from those of *D. majuscula*, being very concave on each side, and wider and more broadly rounded at the apices; rostrum about reaching the posterior coxæ.

Long. excl. tegm., ♂ 48 millim., exp. tegm. 115 millim.

Hab. Continental India, Karwar (*Atkinson*).

Cicada coronata, n. sp.

♂. Body above ochraceous; anterior margin of front, a broad transverse fascia at base of head, extending between and behind the eyes, a narrow fascia near lateral margins of pronotum, and a small central transverse linear spot at base of same, four obconical spots at anterior margin of pronotum (the central pair smallest), an irregular spot in front of cruciform elevation, and anterior margins of abdominal segments, black. Body beneath and legs ochraceous; opercula ochraceous, with the lateral margins greyish and with a black spot at inner apical angles; abdomen beneath with the anterior segmental margins, the apical segment, and apex of abdominal appendage black.

The opercula are long and overlapping at inner margins, their outer margins slightly concavely sinuate, their apices convexly rounded; the rostrum reaches the posterior coxæ.

Long. excl. tegm., ♂ 28 millim., exp. tegm. 74 millim.

Hab. Sumatra (*Van Lansberg*, Leyden Mus.).

KAMALATA, gen. nov.

This genus is allied to *Baturia* and *Karenia* by having the anterior margins of the first dorsal segment of the abdomen neither produced nor sending forward a lobe, thus rendering the tympana visible. Its principal characteristic is found in the vertex of the head, which is laminately produced on each side in front of the inner margin of the eyes in somewhat rectangular processes.

The body is very robust, the abdomen broad and moderately inflated, its lateral margins distinctly keeled beneath; the opercula are short, as in the genus *Pomponia*; the rostrum in the typical species here described about reaching the posterior coxæ, its second joint somewhat compressed laterally and dilated and deeply grooved above; anterior femora robust and spined beneath at apex. Tegmina short, broad, about as long as the body, apical areas eight in number, first longer than the second, basal ulnar area very slightly amplified anteriorly.

Kamalata pantherina, n. sp.

Body above and beneath dark chocolate-brown; head with a longitudinal fascia to front, the margins and a transverse fascia to the ampliations in front of eyes, and a transverse spot at anterior margin of vertex, behind which are two outwardly curved lineate spots ochraceous, eyes luteous; pronotum with

a central black hour-glassed shaped fascia somewhat margined and streaked with ochraceous, the posterior margin also ochraceous; mesonotum with two longitudinal waved linear fasciae, between which near anterior margin are two oblique spots, and the cruciform elevation ochraceous; abdominal segmental margins ochraceous; apices of the femora luteous, anterior and posterior tibiae annulated at base, intermediate tibiae both at base and apex with fuscous.

Tegmina pale greenish ochraceous-hyaline, the venation brownish ochraceous; a large pale fuscous spot at bases of second, third, fourth, fifth, and seventh apical areas, some small spots at bases of sixth and eighth apical areas, two very small spots on the margins of third ulnar area, and a series of large marginal spots at the apices of the longitudinal veins to apical areas. Wings pale hyaline, the venation brownish ochraceous.

Long. excl. tegm., ♂ 34 millim., exp. tegm. 75 millim.

Hab. Sumatra (Leyden Mus.).

VII.—Preliminary Notice of new Fossil Chelonia.

By R. LYDEKKER, B.A., F.G.S.

AULACOCHELYS, gen. nov.

I propose this name for *Trionyx circumsulcatus*, Owen, from the Upper Eocene (Lower Oligocene) of Hordwell, which differs from all species of *Trionyx* by the presence of a deep groove in the free border of the costals.

Trachyaspis aegyptiacus, sp. nov.

This species is based on a nearly entire carapace in the Natural-History Museum (no. R. 229) which was obtained during the excavation of the Suez Canal from beds of unknown, but probably Tertiary, age. It is distinguished from the typical *T. Lardyi*, Meyer, of the Swiss Miocene, by the much narrower neural shields.

Trachyaspis has been hitherto known only by detached fragments of the carapace, and has been regarded as allied to *Trionyx* or *Tretosternum*. That it has nothing to do with the former is evident from the presence of epidermal shields; and I am inclined to think from the evidence of the nuchal region of the present specimen that it is equally removed from the latter, of which the affinities are with the Chelydridæ. The nature of the sculpture of the carapace is an

exaggeration of that found in the existing American genus *Dermatemys*; and since the general contour of the neural shields is the same as in the latter, it appears probable, although the evidence is not conclusive, that *Trachyaspis* is an allied form.

Trachyaspis hantoniensis, sp. nov.

A marginal in the Natural-History Museum (no. R. 1443) indicates the occurrence in the Upper Eocene of Hordwell of a species of *Trachyaspis*, which, from its much lower geological horizon, is probably specifically distinct from the type form; while its distance in space may be an argument for its distinctness from the Egyptian species.

Anostira anglica, sp. nov.

An anterior marginal and a xiphiplastral from Hordwell preserved in the Museum (nos. 33198, *x*, *y*) appear to indicate a Chelonian which cannot be generically distinguished from the genus *Anostira*, Leidy, of which the type species is from the Upper Eocene of the United States. The larger size of the present specimens and the absence of distinct radiation in the sculpture afford a specific diagnosis from the type.

VIII.—*The Systematic Position of Meiolania*, Owen.

By Dr. G. BAUR, New Haven, Conn.

THERE are at present three different views about the systematic position of *Meiolania*. According to Sir Richard Owen* *Meiolania*, together with *Megalania*, belongs to a suborder Ceratosauria, with affinities with both the "orders Chelonian and Sauria."

Prof. Huxley† considers the animal most nearly allied to the Chelydridæ and Platysternidæ.

Mr. Boulenger‡ comes to the conclusion that, far from

* Owen, R., "On parts of the Skeleton of *Meiolania platyceps* (Owen)," Phil. Trans. 1888, pp. 181-191, pls. xxxi.-xxxvii.

† Huxley, Thomas H., "Preliminary Note on the Fossil Remains of a Chelonian Reptile, *Ceratochelys sthenurus*, from Lord Howe's Island, Australia," Proc. Roy. Soc. London, vol. xlii. 1887, pp. 232-238.

‡ Boulenger, G. A., "On the Systematic Position of the Genus *Mirolania*, Owen," Proc. Zool. Soc. 1887, pp. 554-555.

bearing any affinity to the Chelydridæ or Platysternidæ, the extinct Chelonian belongs, like the recent forms of the Australian region, to the group Pleurodira.

I am indebted to Dr. H. Woodward for permission to examine the material of *Meiolania* in the British Museum.

There can be no doubt whatever that *Meiolania* is a Chelonian; and the only question is, does it belong to the Cryptodira (the opinion held by Prof. Huxley) or to the Pleurodira (the view of Mr. Boulenger)?

Mr. Boulenger's reasons for the Pleurodiran nature of *Meiolania* are the following:—

"1. The pterygoids are very broad, not narrowed posteriorly; their outer palatal borders, instead of being emarginate, form wing-like expansions.

"2. The tympanic cavity is completely surrounded by the bony 'roof,' whilst in all known Cryptodira, however great the development of the roof, the tympanic disk is free behind.

"3. The mandible articulates with the skull by a condyle fitting into an articular concavity of the quadrate—a character by which the Pleurodiran Chelonians differ from all other Reptilia, so far as I am aware.

"4. The cervical vertebræ are those of a Pleurodiran; a strong and long transverse process is present, and the posterior borders of the odontoid bone and of the second centrum are deeply emarginate inferiorly, terminating in two diverging processes exactly as in *Chelys*."

Now let us consider the principal characters of the skull of the Pleurodira, and see how far we find these in *Meiolania*.

The principal characters in the skull in the living Pleurodira are:—

1. The quadrate is connected with the basisphenoid, sometimes with the basioccipital also (Podocnemididæ); in all the Cryptodira and the Trionychoidæ the pterygoids extend between these elements.

2. The prefrontals are without descending processes joining the vomer (Cope).

3. The pterygoids are turned up at the anterior outer ends.

4. The front of the brain-case, between quadrate and petrosal (prootic), is not produced, but smooth. (The only exception among the Cryptodira, which all show this production, is found in *Dermochelys*.)

5. There is no free epipterygoid (columella).

6. The tympanic cavity is more or less surrounded by the extension of the quadrate.

7. The condyle of the lower jaw is more or less convex and fits into a concavity of the quadrate*.

If *Meiolania* belongs to the Pleurodira we ought to find the above characters.

1. The sutures between the pterygoids and the adjacent elements cannot be distinguished in *Meiolania*; a comparison, however, of the skull of *Meiolania* with the skulls of representatives of the different families of the Pleurodira proves that the pterygoids extend between the quadrate and basisphenoid. This view is also suggested by the position of the foramen pterygoideum.

In the Pleurodira this foramen is situated free on the base of the skull between the pterygoids and the basisphenoid; in *Meiolania* it is placed far back as in the Cryptodira.

2. *Meiolania* has very strong descending processes to join the well-developed vomer, a character of the Cryptodira.

3. The pterygoids in *Meiolania* are not turned up at the anterior end, as in all Pleurodira. Mr. Boulenger states that their outer palatal borders, instead of "being emarginate, form wing-like expansions."

The same character we find in the Trionychidæ and very often in the Testudinidæ among the Cryptodira. The want of this emargination therefore is not unique for the Pleurodira.

4. The front of the brain-case, between quadrate and petrosal, is produced as in the Cryptodira.

5. In regard to the epipterygoid I cannot give a definite opinion, but I suppose that it was present.

6. There is a thin bony layer extending behind over the tympanic cavity; but this layer is not a part of the quadrate as in all the Pleurodira, but it represents only an extension of the dermal ossifications so highly developed in the skull of *Meiolania*. This dermal ossification reaches *behind* the quadrate, and just this condition proves its dermal origin; in no other Chelonian do we find a posterior process of the quadrate.

7. The condyle of the lower jaw is not visible, the latter being not separate from the skull. The articular face of the quadrate, however, is very distinctly shown in some of the remains. I cannot find any essential difference between this face and that in some of the Testudinidæ; besides, I do not give much value to this character, only well developed in the Podocnemididæ among the Pleurodira.

* The condyle is well developed in the Podocnemididæ and Sternotheridæ, but not distinct in the Chelydridæ.

We see there is not a single definite character in the skull of *Meiolania* which could prove its *Pleurodiran* nature.

The cervical vertebræ form another evidence for the systematic position of *Meiolania* among the *Pleurodira*, according to Mr. Boulenger.

Only the first two vertebræ being present in *Meiolania*, we may at first examine what are the principal characters of the first two cervical vertebræ in the *Pleurodira*.

1. The centrum of the first vertebra (the so-called odontoid process) is absolutely free from the second, with which it articulates freely.

2. It is the centrum which supports the neuroids of the atlas; the first intercentrum (hypapophysis) is very small, free or coossified with the atlas-centrum. The atlas therefore looks very much like the other cervical vertebræ, especially in the *Sternotheridæ* and *Chelydridæ*. The *Podocnemididæ* show the same character; but the atlas-centrum is not so elongate and the neuroids are not ossified as in the other *Pleurodira*. The first intercentrum is very small, free, and slightly connected with the neuroids; but there is never an "atlas-ring."

3. In all the *Pleurodira* well-developed diapophyses are present, in the second and all the following cervicals they are placed in the middle of the vertebræ.

4. In none of the *Pleurodira* does the diapophysis of the first vertebra form a foramen with the first intercentrum.

Now what do we find in *Meiolania*?

1. The centrum of the first vertebra is not absolutely free from the second, but more or less connected, as in the *Cryptodira*.

2. The first intercentrum is very large and supports the neuroids of the atlas, forming an atlas-ring, exactly as in the *Cryptodira*.

3. There is a very well-developed diapophysis on the second vertebra, not placed in the middle, but on the anterior part of the vertebra, exactly as in *Staurotypus* and especially in *Testudo polyphemus* and other *Cryptodira*.

4. The diapophysis of the neuroids of the atlas forms a foramen with the first intercentrum exactly as in *Staurotypus*, *Testudo polyphemus*, and other *Cryptodira*.

We see that the cervical vertebræ are not at all *Pleurodiran*, but truly *Cryptodiran*.

How Mr. Boulenger could compare the cervicals of *Meiolania* with those of *Chelys* I do not understand. There could not be a greater fundamental difference.

The so-called *Pleurodiran* characters of Mr. Boulenger do

not exist in *Meiolania*, and there can be no doubt whatever that *Meiolania* is a true *Cryptodiran**.

The question now arises, to which group of the *Cryptodira* does *Meiolania* belong? Prof. Huxley says that it is "closely allied to the living *Chelydra*, *Gypochelys*, and *Platysternum*."

But the *Platysternidae* have nothing in common with the *Chelydridæ*; they belong to quite a different group together with the *Testudinidae* and *Emydidae*. Therefore *Meiolania* cannot be genetically allied to both.

The only similarity between the *Platysternidae* and *Chelydridæ* consists in the appearance of the skull and the opisthocœlian nature of a part of the caudal vertebræ. Both these similarities, however, are the result of parallelism only.

The opisthocœlian caudal vertebræ are of secondary nature.

All *Testudinata* have the second sacral vertebra convex behind. There is no exception whatever. Prof. Leidy†, it is true, states that "the posterior articular surface of the second [sacral] centrum is concave" in *Bæna*. But this is not correct: what Prof. Leidy describes as the posterior articular surface of the second is the anterior of the first sacral vertebra. The second sacral vertebra of *Bæna* is convex behind, as in all other *Testudinata*. Therefore the first caudal vertebra must be either concave-convex (procœlous) or biconcave, never convex-concave (opisthocœlous) or biconvex. *In fact it is always procœlous*, and so are the next following vertebræ. Now if opisthocœlian vertebræ are found in the caudals of some *Chelonians*, it can only be produced by the interference of an amphicœlian vertebra; and this is the case in *Chelydra*, *Macrochelys*, *Platysternum*, and must also be in *Bæna* and *Meiolania*.

In *Platysternum* (one specimen) the fourth caudal vertebra is biconcave, in *Chelydra* and *Macrochelys* the third or fourth. Prof. Huxley thinks that perhaps *Staurotypus* may also have opisthocœlian vertebræ; but this is not the case.

That the opisthocœlian caudal vertebræ of *Chelonians* are of secondary nature is also proved by palæontology. In *Toxochelys*, Cope, an indubitable *Chelydroid*‡ from the Cretaceous, the caudal vertebræ are procœlous.

* Another support of this view is given by the caudal vertebræ; there are well-developed paradiapophyses in the caudals of the *Pleurodira*; in *Meiolania* we have well-developed caudal ribs (as in *Cryptodira*) coossified with the centrum.

† Leidy, Jos., 'Contributions to the Extinct Vertebrate Fauna of the Western Territories,' Washington, V., 1873, p. 108.

‡ I may notice here that *Anosteira*, Leidy, placed by Cope among the *Chelydridæ* and by Boulenger among the "*Pseudotrionychidæ*," belongs

Opisthocælian vertebræ are present in those *Chelonians* which have long free tails.

There are *Testudinata* with nearly as many caudal vertebræ as *Chelydra* and the others, but in all these the tail is not free, but covered for the greater part by the carapace, and we never find opisthocælian vertebræ.

Together with the opisthocælian vertebræ we always find well-developed intercentra (chevron bones). They may be present in rudimentary condition in long tails without opisthocælian vertebræ, as in *Emys europæa* and *Blundinji*, in *Chelymys victoriæ* at the posterior end of the tail, and in others. In *Toxochelys*, Cope, they are even well developed.

It was especially the caudal vertebræ of *Meiolania* which led Prof. Huxley to the conclusion of its affinity with the *Chelydridæ*; but I think that this character is not conclusive. I imagine that opisthocælian caudal vertebræ could be developed in any group of the *Chelonians*. These characters are adaptive and cannot be used for the genetic relations of groups.

But how can we determine the systematic position of *Meiolania* among the *Cryptodira*?

That *Meiolania* is a terrestrial herbivorous *Cryptodiran* there is no doubt. The only true terrestrial herbivorous *Cryptodira* we know are the *Testudinidæ*; some more or less terrestrial forms we find also among the *Emydidæ*.

We know that the true *Testudinidæ* originated from *Emydidæ*. Why is not *Meiolania* also a true *Testudinid*? Or did it take its origin from one of the other families of the *Cryptodira*, the *Chelydridæ*, or *Staurotypidæ*, the *Cinosternidæ*, or another family?

I am inclined to consider Meiolania as a highly specialized branch of the true land-tortoises, the Testudinidæ, the true Testudinid characters of which are only obscured by the enormous development of dermal ossifications, especially on the skull, which gave to it quite an extraordinary appearance.

My reasons are the following:—

The lower face of the skull resembles most the *Testudinidæ* among the *Cryptodira*.

The long vomer has the strong characteristic keel. The situation and form of the foramina palatina are just as in this family, and so are the pterygoids.

either to the *Staurotypidæ* or to the *Cinosternidæ*. There are only ten peripheralia (marginal bones), and the dermal plates are not entirely absent.

It is only in the Testudinidæ among the Cryptodira that we find forms with pterygoids not emarginate in front. *Testudo tabulata* and some of the gigantic tortoises show it especially.

I cannot give much value to the apparent expansion at the posterior half of the pterygoids; it may be that it is produced by crushing of the edges, and even if it were natural, it would not be of great importance; the Trionychoidea show all stages of these expansions; in some we have no trace, in others they are very well developed.

The hyoid bones of *Meiolania* are of the same form as in the Testudinidæ.

The anterior nasal opening in *Meiolania platyceps* is divided by a process connecting the premaxillaries with the prefrontals.

In *Meiolania Oweni* this process is interrupted in the middle.

Indications of such processes showing a tendency to divide the anterior nasal openings we find *only* in the Testudinidæ. In most of these a sharp ascending process is developed from the premaxillaries, and also one descending from the anterior end of the prefrontals.

There may be an objection; the fissure for the stapes in the quadrate is open in *Meiolania*, closed in all the known Testudinidæ, so far as I am aware. An open fissure of course is the original condition. But if we have in one family—the Chelydridæ—both conditions, we cannot lay very much stress upon that. *Chelydra* and *Macrochelys* have the fissure closed, *Toxochelys* has it open.

Another objection may be that there is not a single form of the Testudinidæ with the temporal fossæ completely arched over and with the quadratojugal region so much developed as in *Meiolania*.

Of course there is none! But in *Meiolania* we have to distinguish between true ossifications of the skull and dermal ossifications!

I believe that the whole posterior half of the skull of Meiolania is modified by the enormous development and extension of dermal ossifications, in the same way as the skull of Phrynosoma.

In some of the Lacertilia we have only horny scales, without any ossifications; in *Phrynosoma*, however, we find ossified horn-cores not separable from the bones of the skull.

I think that the dermal ossifications in the skull of *Meiolania* have originated in the same way as I have indicated

for the same ossifications in the skin of the limbs in the Testudinidæ.

There were at first horny scales, which developed more and more; on some of these ossifications appeared which were entirely free from the bones of the skull. By the extension of these ossifications they were at first suturally connected with each other, forming a solid layer over the bones of the skull; the sutures disappeared and the dermal ossifications united with the bones of the skull, forming one continuous mass.

I think therefore that the peculiar appearance of the skull of *Meiolania* is no objection against its Testudinid nature.

The pelvis and especially the cervical vertebræ also compel me to consider *Meiolania* allied to the Testudinidæ.

The two cervical vertebræ preserved are essentially identical in form with those of *Testudo polyphemus*.

I at first thought that these parts were very much like the corresponding ones in *Staurotypus*, a fine skeleton of which I was able to examine through the kindness of Prof. von Krauss, of Stuttgart.

In *Staurotypus* the neuroids of the atlas and the second vertebra have very strong diapophyses, more developed than in any other Cryptodiran I know. There is likewise a foramen between the diapophysis and the first intercentrum of the atlas.

But in *Staurotypus* I find, just as in the Chelydridæ, a very strong lamellar process on the lower part of the second vertebra, which is entirely absent in *Meiolania*.

It is also absent in *Testudo polyphemus*.

Here we have, precisely as in *Meiolania*, a well-developed diapophysis on the neuroids of the atlas. The first intercentrum is very well developed, and there is the foramen between it and the diapophysis.

The posterior part of the atlas-centrum and that of the axis is deeply emarginate, as in *Meiolania**, and the second vertebra has a very well-developed diapophysis of the same form and the same position as in *Meiolania*.

More could be said, especially with regard to the geographical distribution of the Testudinidæ and the peculiar evolution of this family in some islands; but the consideration of these points would take me beyond the limits of this communication.

Further discoveries will prove whether the opinion on the

* These emarginations are formed by the union of the corresponding intercentra with the posterior part of the vertebræ.

systematic position of *Meiolania* brought forward here is true or not, and I hope that the decision may be given soon.

Nov. 11, 1888.

Note.—Since the above was written I have examined the caudal vertebræ of two specimens of *Clemmys insculpta*, Ler., one of the Emydidæ, with a pretty well-developed tail.

In one I found *opisthocœlian* vertebræ, in the other true opisthocœlian vertebræ were not present, but the tendency was there to form such vertebræ.

First specimen.—Caud. 1-7 concave-convex; caud. 8 biconcave; caud. 9 and the next following *convex-concave*.

Second specimen.—Caud. 1-7 concave-convex; caud. 8 concave-plane; caud. 9 biconcave; caud. 10 biconcave; caud. 11 plane-concave; caud. 12 biplane; caud. 13-15 concave-plane; caud. 16 biconcave, also the following.

Between the vertebræ well-developed cartilaginous intercentra are found, like those in *Sphenodon*, only between the 8th and about the 15th caudal they are ossified and represent chevrons.

The question of course is whether the Platysterniæ, characterized by the opisthocœlian caudal vertebræ, can now be considered as a distinct family. *Platysternum* comes nearest to the ancestors of Emydidæ, which still had the inframarginals well developed. I think it best to consider it as belonging to a subfamily—the Platysterninæ.

BIBLIOGRAPHICAL NOTICE.

Die Calaniden Finlands. Von Osc. NORDQUIST. 8vo. Finnische Litteratur-Gesellschaft, 1888.

ATTENTION was particularly called to the occurrence of marine forms of life in fresh waters by Dr. E. von Martens some thirty years ago, and since then the investigations of naturalists have demonstrated the presence of such types in nearly all parts of the world. Among the earliest researches were those upon the Swedish lakes, which revealed phenomena of great interest, especially in connexion with the geographical features of the region, and in Finland Malmgren and others noticed the presence in the fresh waters of species of *Mysis*, *Pallasea*, *Gammaracanthus*, and *Pontoporeia*. Little, however, was done with respect to the Entomostraca of Finland.

The author has for some time been engaged in the investigation of the Finnish Copepoda, and his present work, treating of the Calanidæ, is the first outcome of his researches. In it he records the whole of the Calanidæ of Finland, whether marine or freshwater, and discusses in considerable detail the various questions as to their origin and the changes which they may have undergone, questions which acquire particular importance from the peculiar conditions of existence under which the animals live in the more or less brackish waters of the Gulfs of Bothnia and Finland, becoming nearly fresh at the northern extremity of the former, and in the numerous lakes with which the surface of the country is dotted, including among these the great Lake Ladoga.

As to the origin of the fauna of the Baltic, including, so far as the Calanidæ are concerned, the neighbouring freshwaters, two distinct views have been put forward, one of which derives the marine fauna from the North Sea, while the other assumes that at a late geological period the Baltic was a gulf of the Arctic Sea, from the inhabitants of which the animals now found in it have descended. Dr. Nordquist seems inclined to think that both modes of introduction may have had to do with the constitution of the present fauna; as regards the Calanidæ he finds that nearly all of them are represented in the North Sea, and that the Baltic specimens are more or less reduced in stature somewhat in proportion to the diminution of the amount of salt in the water.

Thus he describes in all twelve species, one of them represented by two named varieties, namely:—*Centropages hamatus* (Lillj.), *Limnocalanus macrurus*, Sars (= *Centropages Grimaldii*, de Guerne), *Clausia elongata*, Boeck, *Temora longicornis* (O. F. Müll.), *Temorella affinis*, var. n. *hirundoides*, *T. affinis*, var. n. *hispida*, *T. lacustris*, Poppe, *T. Clausii*, Hoek, *Hetercope appendiculata*, Sars, *H. saliens* (Lillj.), *Diaptomus gracilis*, Sars, *Dias longirostris* (Lillj.), *D. bifilosus*, Giesbrecht, all of which are fully described and figured in detail upon two quarto plates. Of these by far the greater part of the marine forms occur either in the North Sea or in the Bay of Kiel or in both, and a table of measurements shows a gradual decrease in size from the open sea to the northern parts of the Baltic. Of all the species the only one which seems to the author to be probably a relic of the supposed invasion from the north is *Limnocalanus macrurus*, which has not been found in the North Sea, and of which he says we "must assume either that it has been produced in the Baltic or in the lakes, or that, like the other relic-forms, it is a remnant of Arctic fauna. Against the former supposition, however, is the fact that this species also occurs in the lakes of North America; and it is therefore more probable that it has come from the icy sea both into the North-American and Scandinavian lakes." As the ova of this form are not carried about by the female, but sink to the bottom after extrusion, it can in this case only be regarded as a relic-form, a view which is further supported by the circumstance that *Limnocalanus* never occurs at a higher level than the other relics.

The above is a very imperfect account of a most interesting treatise; but the fact is that in order to do more it would have been necessary to translate almost the whole work. We may add that it is written in German and that the plates furnish greatly enlarged figures of the characteristic parts of the animals described.

MISCELLANEOUS.

Preliminary Note on the Functions and Homologies of the Contractile Vacuole in Plants and Animals. By PROFESSOR MARCUS M. HARTOG, D.Sc., M.A.*

THROUGH the practice of regarding botany and zoology as essentially distinct studies the solution of many an interesting problem in the one domain is long missed, because the known facts that afford a clue when properly applied have been worked out only in the other, and are contained in records never likely to be consulted in reference to the given problem. Thus the "contractile vacuole" is an organ that exists in both kingdoms: the question of protoplasmic vacuolation, of which this is a particular case, has only been really studied by the vegetable physiologist, and yet in the minute plant-cells which possess this organ it is too small for the study of the mechanism of its work: this study has been successfully carried out by zoologists on the larger Ciliata and Heliozoa, in ignorance, however, of the known facts that explained the reason of its working. Thus the botanists had forged a key of the right pattern, but too big to open the locks in their own domain, while fitting that of which the zoologists had described the wards and tumblers. In this preliminary communication I shall only put the key into the lock, reserving original observations for a complete paper.

I. *Distribution*.—One or more contractile vacuoles occur in all naked plant-zoospores, with scarcely a recorded exception, whether mastigopod or myxopod, whether Algal, Fungal (Saprolegniacæ, Peronosporacæ, Chytridiacæ), or Myxomycete. They occur in all freshwater Protozoa when in the active state, though not when encysted; they are, however, absent from many of those that live in the perivisceral fluid or blood of living hosts and from the Radiolaria and possibly other marine forms.

II. *Position and Mechanism*.—They are vacuoles in the protoplasm, usually peripheral; they contract to disappearance at regular intervals; in favourable cases (*Actinospharium*, many Ciliata) they are seen on contraction to discharge their contents into the water. In a few cases they are known to be reservoirs filled gradually by the almost continuous influx from plasmatic canals, which are invisible from this very reason, only starting into sight

* Read at the British Association (Bath), 1888.

normally during the momentary pause, when, owing to the contraction of the vacuole, their liquid contents have time to accumulate and distend them.

Now if a specimen of sufficient size, say a *Paramecium*, be placed under certain unfavourable conditions (among which is deficiency of oxygen), we find that the contractile vacuoles contract less perfectly and at longer intervals, the plasmatic canals become persistently visible and enlarged, the whole animal becomes dropsical, its thin cuticle bursts, and its protoplasm, no longer protected by the 'Hautschicht' and cuticle, and exposed directly to the water, disintegrates into "diffluence."

Again, if a vegetable cell be wounded in water and its protoplasm passes out it rounds off and surrounds itself with a Hautschicht; then vacuoles appear inside: these enlarge enormously and finally burst; the protoplasm so exposed without a Hautschicht to the water disintegrates into diffluence, just like the Ciliate whose contractile vacuole works inefficiently. This pathological vacuolation and diffluence do not occur if to the water there be added a sufficiency of sugar, saltpetre, glycerine, or other innocuous osmotic substance; and when the protoplasm has the power of excreting a complete cellulose wall, as in *Vaucheria*, the incipient vacuolation is arrested on the formation of the wall.

The explanation of both series of facts is the same, as worked out by a number of botanists from Von Mohl to De Vries:—

Protoplasm contains in its interstices substances of high osmotic value; its outer layer at least, while freely pervious to water, is slightly if at all pervious to these substances even in solution. Hence, when protoplasm is immersed in water, cavities or vacuoles form in its substance containing solutions of these substances, which continue to enlarge by attraction of water from without; the enlargement produces a tension which De Vries and others have by various methods determined to be at least three atmospheres, and which may reach fifteen atmospheres. Now, naked protoplasm has very little toughness; it yields readily to the increasing tension and to the expansion of the vacuole, and finally bursts and disintegrates. On the other hand, cellulose and chitinous cyst-walls are sufficiently tough to resist; and equilibrium is attained when, after a certain amount of stretching, the elasticity of the wall balances the tension of the vacuoles due to osmosis.

If, however, in the absence of a tough wall the vacuole, instead of extending indefinitely and bursting irregularly, (a) opens by a minute pore, (b) contracts regularly as it expels its contents, (c) closes up simultaneously with the completion of their expulsion.—then no part of the inner protoplasm is exposed directly to the water, and we have a mechanism which expels regularly the plasmatic juice or cell-sap when over-diluted and over-abundant, and which prevents the destruction of the protoplasm by bursting and diffluence. This is the mechanism of the contractile vacuole, which is thus a physiological necessity to the naked cell living in water, just as the kidney is to the multicellular animal organism.

I will add one unpublished observation to the well-known facts here brought together. Two sporanges of *Saprolegnia* opened at an early stage of the partial segregation of the protoplasm into masses. Part of the protoplasm in each slowly escaped and aggregated into rounded masses. The first discharged masses underwent the usual pathological changes and diffuence; the later masses (from both sporangia) had already acquired the power of forming contractile vacuoles possessed by the zoospores; the numerous small vacuoles appeared and contracted regularly, lines of separation formed and deepened, and the masses divided into zoospores, which separated and swarmed, just like the protoplasm which remained in the sporange, though more slowly. This observation seems to afford a crucial test of the truth of the thesis that the contractile vacuole has the function of preventing excessive vacuolation and diffuence of naked cells in water.

The following is a brief summary of the points on which the above thesis rests:—

1. All naked protoplasmic bodies living in fresh water have at least one contractile vacuole.
2. The possession of this is quite independent of the systematic position of the organism and of the presence of chlorophyll*.
3. The vacuole loses its contractility on the formation of a strong cell-wall or cyst, and may even disappear.
4. It is absent from Gregarinida and Opalina and the Radiolaria which inhabit saline liquids.
5. When, owing to morbid conditions, the efficiency of the contractile vacuole is impaired, excessive vacuolation and diffuence ensue.

6. Conversely, as soon as contractile vacuoles appear, the tendency to excessive vacuolation and diffuence is arrested.

It may be suggested that the perforations of the nephridial cells in Vermes and embryonic mollusks and of the epiblastic gland-cells of Vermes and Arthropods are due to the persistence of the contractile vacuole, the opening of which has become permanent, while its contractility has been superseded in the kidneys at least by other arrangements. Even the goblet-cells of mucous epithelia may possibly be traced to this origin.

On Adelphotaxy, an undescribed Form of Irritability.

By Professor MARCUS M. HARTOG, D.Sc., M.A.†

In *Achlya*, a genus of Saprolegniæ, the zoospores lie in the sporange before liberation closely appressed together, with their long axes parallel, instead of showing the rotatory hustling movements of other species. On liberation, instead of separating and swimming

* Hence the function cannot be exclusively respiratory, though it may aid respiration.

† Read at the British Association (Bath), 1888.

off, each on its own account, they remain near the mouth of the sporange, each in turn edging its way in between those that have already escaped, with its narrower flagellate (anterior) end inwards. They thus form a hollow sphere, each zoospore rotating round its long axis (radial to the sphere) before encysting in its place. The only explanation that will fit these phenomena is that these zoospores are endowed with a peculiar irritability, in virtue of which they tend to place themselves close together side by side, with their long axes parallel. This irritability is only exerted at a short distance; for if a zoospore be pushed as little as its long diameter away, whether by accident or design, it fails to find its place, but swims off to and fro, instead of rotating *in situ*, before encysting.

In a critical review of a paper by Rothert, I have given the name "*adelphotaxy*" to this form of irritability, *consisting in the tendency of spontaneously motile cells to assume definite positions with regard to their fellows.*

Leaving aside the kindred question of tissue-formation and the processes in the embryo-sac of Phanerogams, adelphotaxy is of rare occurrence in the Vegetable Kingdom. Two good instances occur in the Chlorophytes. In *Pediastrum* the contents of each cell of the flat disk break up into sixteen (or thirty-two) zoospores, which swarm in the cell and then unite edge to edge to form a new disk. So in each cell of a *Hydrodictyon* the many thousand zoospores unite end to end to form a new network with hexagonal meshes.

In many of the Myxomycetes the plasmodia aggregate together before fructification to form the compound masses termed aethalia; possibly even the very formation of plasmodia may be regarded as a mode of adelphotaxy.

We may perhaps go a step further and describe the parallel or converging courses of *Fungus hyphæ* to form mycelium-strings, fruit-bodies, and pseudo-parenchyma as extreme cases of adelphotaxy.

I think this principle affords a ready explanation of many cases of cellular aggregations in the animal embryo and the formation of the spermatophores of many animals, notably Limicolous worms.

The relations of sexual and isogamous union of gametes to adelphotaxy are obvious; for, though in some cases of sexual union chemotaxy has been shown by Pfeffer to be involved in bringing the active gamete from a distance, that will not cover the actual fusion of the two cells.

What may be the mechanism of adelphotaxy it is impossible to see at present; but its existence as a distinct mode of irritability must now be recognized.

On the Hersiliidæ, a new Family of Commensal Copepoda.

By M. EUGÈNE CANU.

The author has discovered at Wimereux two new genera, very nearly allied to *Hersilia* and commensals of various Invertebrates,

and he has come to the conclusion that the Hersilians constitute a new family equally distinct from the Siphonostomata and the Pelidiids. He considers that in the ontogeny of the most diverse types the first rank in order of appearance is to be given to characters drawn from the buccal appendages, and he has employed these characters prominently in the following diagnoses :—

Family HERSILIIDÆ.

Body completely segmented, first thoracic somite united with the cephalic segment. Anterior antennæ 7-jointed, similar in the two sexes. Posterior antennæ simple, 4-jointed. Mandibles without palpi or masticatory teeth, furnished at their distal extremity with movable accessory pieces in the form of a solid and recurved claw, or of flattened laminae with the margins notched and denticulate, or of bearded setæ. Maxillæ rudimentary, divided into an inner masticatory lobe and an external palpiform lobe. Paragnathi much developed, concealing the mandibles. Thoracic feet biramose and with triarticulate rami in the first four pairs; simple and flattened in the fifth.

* Mandibles having at their distal extremity a recurved claw and

A. *Two* accessory pieces :—

1. Of which the anterior is a flattened and notched lamina, and the posterior a small bearded seta. In the male the inner maxillipede is composed of two joints and a greatly reduced prehensile extremity. Genus *Hersilia*, Philippi.

One species :—*H. apodiformis*, Phil. (= *Clausidium testudo*, Kossm.), upon the carapace of *Callianassa* in the Mediterranean and Adriatic.

2. Nearly identical and in the form of flattened denticulate laminae. The inner maxillipede of the male contains, besides the two basal joints, a long recurved claw. Genus *Giardella*, Canu.

The genus is dedicated to Prof. A. Giard. There is one species, *Giardella Callianassa*, Canu, which is abundant in the galleries of *Callianassa subterranea* in the sands of the Pointe-des-Oies, near Wimereux.

- B. *Three* accessory pieces, of which the anterior is a long, notched, subtriangular lamina, and the others two long bearded and flexible setæ. Genus *Hersilioides*, Canu.

Three species :—

1. *Hersilioides Pelseueri*, Canu, found in the tube of a Clymenian which is very abundant at the Pointe-des-Oies.

2. *Hersilioides Thomsoni*, Canu, of which three immature ex-

amples were taken, in the month of April, upon the abdominal feet of *Callianassa*.

3. *Hersilioides Puffini*, Thomson (*Cyclops Puffini*, J. C. Thoms., Proc. Biol. Soc. Liverp. vol. ii. 1887).—*Comptes Rendus*, November 12, 1888, p. 792.

Pebrilla, a new Genus of Infusoria living on the Hermit-crab.

By Prof. A. GIARD.

Prof. Giard, at the close of a notice of the species of *Folliculina* observed on the French coasts, gives a short description of a new form allied to that genus which he proposes to name *Pebrilla paguri*. He has found this Infusorian on the abdomen of hermit-crabs (*Eupagurus Bernhardus*) infested by *Peltogaster paguri* and *Phryxus paguri*, but does not doubt that it may also exist upon healthy subjects. It forms small colonies placed either in the vicinity of the feet or at the posterior extremity of the abdomen of the hermit-crab. These colonies are visible by the naked eye as black patches, which retain their colour even after being long in spirits.

The capsule of *Pebrilla* is of an oblong-ovate form, with a projecting tubercle at the hinder extremity, within which the actual body of the Infusorian is attached; it is strongly constricted transversely in the middle, and the aperture is surrounded by a nearly erect or slightly everted collar. The lobes which surmount the mouth of the Infusorian are shorter than in the *Folliculinæ*, and the nucleus is very large and moniliform. It is not uncommon to find individuals in a state of bipartition or of gemmiparous reproduction.

Pebrilla paguri, like the *Phryxus* and *Peltogaster*, evidently avails itself of the currents of water which circulate along the abdomen of the hermit-crab, and it forms an interesting addition to the long list of commensals of that Crustacean. The specimens on which it was found were collected at Pouliguen and Roseoff, those from the latter locality in 1872, and yet the Infusorians were so well preserved that their vibratile cilia and moniliform nucleus could be clearly seen.—*Bull. Sci. de la France et de la Belgique*, 1888, p. 316, pl. xx. figs. 1, 2.

On the Nutrition of the Protozoa. By Dr. M. MEISSNER.

Dr. Meissner in the first place refers to previous experiments in the feeding of Protozoa, as those made by Count Gleichen-Russwurm in the last century and continued at a later date by Ehrenberg. In both cases the inception of grains of carmine into the body-substance of Infusoria was observed.

The food of the Protozoa is well known to consist of low forms of

Algæ and Fungi and of smaller representatives of the Protozoan world itself. The larger forms even take in small Vermes (Rotatoria) as welcome prey. To ascertain what constituents of the incepted objects are *assimilated* by the Protozoa the animals were fed with the individual materials which enter into the composition of these objects. Starch, fat, and albumen are the chief constituents of the food of the Protozoa. The author has tried what changes these substances undergo in the plasma of the Rhizopoda and Infusoria.

He first of all fed *Amœbæ* with rice-starch by placing a fragment of the size of a pea in a small glass vessel containing vegetable debris, in which the presence of different Rhizopoda had been ascertained. In a few days the inception of the starch-grains could be recognized in several individuals. But these grains underwent absolutely no alteration, although many of them remained for more than a week in the *Amœbæ*.

Hence it appeared that starch-grains are not digested by *Amœbæ*. The author experimented with *Amœba princeps*, *A. radiosa*, *Pelomyxa palustris*, and *Actinophrys sol*.

In the oil-experiments olive-oil coloured with tincture of alkanet was employed. But it proved that this also remained quite undigested after it had been taken up by the animals in the form of very small globules.

Thus it could only be supposed that albumen is the principal nutriment of the Amœbiform organisms, and this supposition was confirmed by experiment. Although the *Amœbæ* are apparently unable to digest boiled albumen, observations upon the fate of the albumen of the Protista taken in showed that in this case a solution takes place. The protoplasm of the swallowed Protozoa, Algæ, and Fungi, after being liquefied, is taken up, or rather absorbed, by the sarcode of the Rhizopods, while the indigestible remains are thrown out.

With regard to the Infusoria Dr. Meissner arrived at very similar results. He made feeding-experiments with *Climacostomum virens*, *Vorticella nebulifera*, and *Peranema trichophorum*. From these it appeared that the Infusoria, when all other nourishment has been extracted, convert the incepted starch into a substance which, when treated with a solution of iodine, is coloured red (dextrine?), and which is afterwards dissolved in the body. Oil, on the other hand, remained quite unaltered, while vegetable and animal albumen was assimilated. Boiled albumen, however, remained unaltered, as in the Rhizopods.

How quickly the solution and assimilation of the albumen take place in many cases is shown by the observed digestion of a *Diffugia* by a *Climacostomum virens*, which only occupied twenty-five minutes. After this lapse of time the Rhizopod was completely digested, and its empty shell remained within a vacuole in the interior of the Infusorian.—*Zeitschr. für wiss. Zool.* Bd. xlv. ; Abstract by Dr. O. Zacharias in *Biol. Centralblatt*, 1888, p. 547.

A Study of the Hydrangea in relation to Cross-Fertilization.

By THOMAS MEEHAN.

That many flowers are arranged for cross-fertilization needs no argument to sustain it, nor is it less certain that some flowers can only be fertilized through the aid of wind or insects. Sprengel, it is well known, in the early part of the present century, placed this beyond doubt. The great question is not, do plants generally cross-fertilize? but why do they do it? Mr. Darwin's great work in this connexion has been to prove that plants abhor in-and-in breeding, that the struggle for life is necessarily the chief object of existence, and that cross-fertilization tends to make the race stronger and better fitted to engage in this struggle than close breeding would do. The results of many of Mr. Darwin's experiments sustain his views, as do those of many others; but to my mind just as large a number do not sustain them. Mr. Darwin himself has candidly stated that continuous self-fertilization does not in the least impair the fertility of the race. Mere negative vigour is the leading advantage he finds in crossed plants. (Cross and Self-fertilization, Chap. IX. p. 327.)

It is not my object now to controvert the views of Mr. Darwin, or of his numerous followers. My view of one object of nature in cross-fertilization is to aid in production of variety. I have shown ever since discussion grew warm on these subjects, that variation is essential to the present order of things,—that nature, to be consistent with herself, must provide for variations if for no other purpose than to make variety. I now propose to show, by some studies in *Hydrangea*, that the variations in the species are of the most contradictory character taken from the standpoint of benefits in the struggle for life, while they are entirely consistent with my view of variation for variety's sake. Our garden *Hydrangea*, from Japan (*Hydrangea hortensis**), has the ray-florets sterile, or rather it is the lateral florets of the compound cyme that give the enlarged sepals, and fail to perfect the gynæcium. The terminal florets are fertile. In *H. quercifolia* all the lateral florets are fertile, and it is only the terminal one that has petaloid sepals and is barren. Will any one assert that these exactly opposite conditions can have any bearing whatever as aids in a struggle for life? Suppose we say that the attractive sepals are given to these species for the purpose of attracting insects, and thus aiding cross-fertilization. With this view we examine the American species *H. arborescens*, and we find barely an attempt to make these enlarged petaloid sepals. There are small ones on a few terminals and this is all. It has made out certainly as well in the great struggle as either of its two brethren. But is it a fact that the showy sepals are given to the plant to attract

* Franchet and Savatier insist that Smith's name of *H. hortensis* has priority over *H. Hortensia*.

insects? There is neither pollen nor nectar in the male flowers of *H. hortensis*. They conceal the terminal hermaphrodites, and it is scarcely probable that many insects, if any, visit the flowers. In the other two, many insects visit the flowers—so far as my observations go, as many visit the *H. arborescens* without the attractive sepals, as the *H. quercifolia* that makes such a show of them.

Turning to the minute fertile flowers on these two species, we are struck by the immense number of stamens and the enormous number of pollen-grains one of these racemose cymes gives us. I estimated the number of stamens on one of *H. quercifolia* at 13,000; shaken over a sheet of dark paper it completely whitens it. Its pollen can be carried by the wind everywhere, why should it develop petaloid sepals to attract insects? Both species have the odour of hawthorn, but in addition *H. quercifolia* has an enormous yield of nectar, which is apparently not abundant in *H. arborescens*. In spite of all the attractions, the petaloid sepals, the abundance of pollen, the delightful fragrance, the superabundance of nectar, and the actual visits of numerous insects, the flowers are self-fertilizing. The outer row of five stamens mature pollen simultaneously with the expansion of the petals, which falls at once on the receptive stigmas, some hours after the inner series mature, and ensures that self-fertilization which the pollen from the first series may possibly have missed. The only possible aid insects can give is in self-fertilization.

It is broadly asserted that we owe to the existence of insects the various forms and colours of flowers with their grateful odours and sweet secretions. Here we have illustrations of the most dissimilar and contradictory variations in a single genus, variations which cover all the leading points called for by the insect-adaptationists, and, so far as any argument in common use goes, could have occurred with as much reason if not a single insect ever existed. The facts are absolutely inexplicable on any theory of the survival of the fittest in the struggle for life; but on my view of the absolute necessity of variation for its own sake the explanation seems simple enough.

Variation is inseparable from even the closest in-and-in breeding. We are as fully justified in saying that nature abhors a perpetuity of form as that she abhors in-and-in breeding, and we can just as earnestly claim cross-fertilization as an agent in bringing about variation for the sake of variety as for the reasons usually given, and which we find we cannot apply with consistency in so many cases.

That cross-fertilization aids variation we may well believe is a sufficient reason for its existence, without assuming that it has no other office to perform.—*Proc. Acad. Nat. Sci. Philad.* 1888, p. 277.

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IX.—*Report on a Second Collection of Sponges from the Gulf of Manaar.* By ARTHUR DENDY, M.Sc., F.L.S., Demonstrator and Assistant Lecturer in Biology in the University of Melbourne.

[Plates III.–V.]

A LITTLE more than a year ago I published in this Journal an account* of a collection of sponges made by Mr. Edgar Thurston, Superintendent of the Government Central Museum at Madras, off the shores of the Island of Ráméswarem in the Gulf of Manaar. Shortly before leaving England I received from Mr. Thurston a second collection, obtained in the neighbourhood of the Tuticorin Pearl Banks. This collection was of even greater interest than the first, and its value was greatly enhanced by the fact that Mr. Thurston had carefully preserved portions of nearly all the species in spirit, and had also kept a record of the colours of the sponges in the living state. Unfortunately my report on this collection has been greatly delayed by pressure of other work, and even now I feel that I have been unable to do full justice

* "The Sponge-fauna of Madras," *Ann. & Mag. Nat. Hist.* ser. 5, vol. xx. p. 153.

to the material at my disposal. To illustrate the Report fully eight or ten quarto plates would have been required, and I was unable to make arrangements for obtaining these before leaving England. I have therefore thought it best, in preference to delaying any longer, to publish full descriptions of the species in this place, together with such illustrations as were practicable under the circumstances.

The pieces preserved in spirit proved of very great service and enabled me to investigate to a certain extent the minute anatomy of one or two of the species, and especially of *Spongionella nigra*, in the case of which it would have been quite impossible without spirit-preserved material to determine the true characters of the sponge. I hope that I may be able to make fuller use of the spirit-preserved material for anatomical investigation at a later date.

The collection comprises twenty-four determinable species, of which fourteen are new to science and two are represented by new varieties. Of the twenty-four species one belongs to the Tetractinellida, nineteen to the Monaxonida, and four to the Ceratosa, and there is also an undeterminable species of *Hircinia*.

Amongst the old species there are several forms of very great interest, chief amongst them being *Axinella tubulata*, a sponge hitherto scarcely known at all and whose peculiar characters, which were most curiously misunderstood by Dr. Bowerbank, are here shown to be due to the presence of a commensal tubicolous Annelid. Amongst the new species the most important is undoubtedly *Spongionella nigra*, of which I give a full account later on.

The colours of the sponges in life were, as usual, very varied and brilliant. Judging from what Mr. Bracebridge Wilson, who has had great experience in dredging sponges in the neighbourhood of Port Phillip, tells me, I am inclined to believe that the colours of the living sponges will be found to be of great service in distinguishing the species. Some idea of the brilliance and variety of the natural colouring may be gained from the following complete list of the species in Mr. Thurston's second collection.

TETRACTINELLIDA.

Tetilla hirsuta, n. sp. (No colour recorded.)

MONAXONIDA.

Petrosia testudinaria, Lamarck, sp. Pink.

Reniera madrepara, n. sp. (No colour recorded.)

- Pachychalina multiformis*, Lendenfeld, sp., var. *manaar-ensis*, nov. Pale violet or light pink.
 — *delicatula*, n. sp. (No colour recorded.)
 — *spinilamella*, n. sp. Pale yellow.
Siphonochalina communis, Carter, sp. Bluish brown.
 — *crassifibra*, n. sp. Deep blue.
Gelliodes carnosus, n. sp. Grey.
Iotrochota baculifera, Ridley, var. *flabellata*, Dendy.
 Black (in spirit or when dry dark purple).
Clathria indica, n. sp. Bright red.
 — *corallitincta*, n. sp. Coral-red.
Rhaphidophylus spiculosus, n. sp. Vermilion.
Hymeniacidon? foetida, n. sp. Grey.
Axinella labyrinthica, n. sp. Bright orange.
 — *Donnani*, Bowerbank, sp. Orange.
 — *tubulata*, Bowerbank, sp. Pinkish red or red.
Ciocalyptra Tyleri, Bowerbank, var. *manaarensis*, nov.
 White.
Auletta aurantiaca, n. sp. Bright orange.
Acanthella Carteri, n. sp. Orange-red.

CERATOSA.

- Spongionella nigra*, n. sp. Black.
Hircinia clathrata, Carter. Reddish brown.
 — ? sp. Blackish grey.
Aplysina purpurea, Carter. Grey (in spirit, or, when dry, dark purple).
 — *fusca*, Carter. (No colour recorded.)

Specimens of all these species, which I shall now describe, are in the British Museum, South Kensington. The spicular terminology here employed is that given in the 'Challenger' Reports on Monaxonida and Tetractinellida.

TETRACTINELLIDA.

Tetilla hirsuta, n. sp.

This species is represented in the collection by two good specimens, each of which is spherical and attached to a stone by the base. The larger of the two specimens is 40 or 50 millim. in diameter. There is no record of the colour of the sponge in the living state, but in spirit the specimens are dark grey, almost black. The surface of the sponge is hirsute, owing to the presence of long spicules projecting outwards and downwards in a thatch-like manner. The con-

tinuity of the surface is interrupted at irregular intervals by a number of pits or depressions, which form a very conspicuous external character. Some of the pits are shallow and hemispherical, others deep and tubular; some have in their floor the evident openings of a number of oscular tubes, while others are lined by a smooth continuous membrane which presents no openings to the naked eye. In sections the floor of a pit is sometimes seen to be perforated by a number of very small pores, which are doubtless inhalant. I have not been able to work out in detail the arrangement of the pores and oscula; but from the examination of my sections I have come to the conclusion that some of the surface-pits are localized pore-areas, while others are oscular areas. This condition recalls that described by Professor Sollas in his *Cinachyra barbata* *; but further investigations are required to enable one to say how far the resemblance holds good; in any case the two species appear to be quite distinct, and the arrangement of the oscula, although in both they are confined to special pits on the surface, appears to be different in the two cases.

The skeleton of the sponge is arranged in a perfectly typical radiate manner, the stout radiating fibres all starting from a dense central nucleus. There is no special cortical skeleton of radiately disposed oxea, such as occurs in *Cinachyra*.

Spicules.—(a). *Megasclera*:—(1) Very long, fusiform, straight oxea, tapering very gradually to a fine point at each end; size about 3·5 by 0·042 millim. (2) *Protriaenes*, with very long and very slender shaft and rather short, sharp-pointed cladi; length of shaft in a well-developed example about 0·46 millim., diameter about 0·014 millim.; length of cladi about 0·049 millim., diameter at base about 0·007 millim. These spicules are often of hair-like dimensions. (3) *Anatriaenes*, with shaft perhaps somewhat shorter than that of the *protriaene* and often of hair-like thinness.

(b). *Microsclera*:—Very small slender sigmaspires, about 0·022 millim. long.

Concerning the details of the histology and canal-system of this sponge I am not able to give much information. It is difficult to work out, owing to the great development of spicules, and I have only the smaller of the two specimens at my disposal. The ectosome is fairly thick and gelatinous, with a tendency to become fibrous. The choanosome presents

* Report on the Tetractinellida of the 'Challenger' Expedition, p. 23.

a condition intermediate between collenchymatous (gelatinous) and sarcenchymatous (granular). The flagellated chambers are more or less spherical and about 0·02 millim. in diameter; their mode of opening I have not been able to determine precisely.

MONAXONIDA.

Petrosia testudinaria, Lamarek, sp. (Pl. III. figs. 1, 2, 3.)

1815. *Aleyonium testudinarium*, Lamarek, Mémoires du Muséum d'Histoire naturelle, tome i. p. 167.

1882. *Reniera crateriformis*, Carter, Ann. & Mag. Nat. Hist. ser. 5, vol. x. p. 115.

1884. *Reniera testudinaria*, Ridley, Zool. Coll. H.M.S. 'Alert' (Brit. Mus.), p. 409.

1887. *Reniera crateriformis*, Carter, Journ. Linn. Soc., Zool. vol. xxi. p. 71.

This species is represented in the collection by a single very fine cup-shaped specimen (Pl. III. fig. 1). It measures 40 centim. in height and 127 centim. in maximum circumference; the longer diameter of the aperture of the cup is 38 centim., the shorter diameter 17 centim., and the depth of the cup 18 centim.; the diameter of the base of the sponge is 30 centim.

The outer surface of the sponge is beset with very prominent parallel ridges running vertically upwards; these ridges are much better defined and more regular and continuous than in any other specimen in the British-Museum collection; their average height is 4 or 5 centim. and the average distance between them is 5 centim.

The colour of the sponge in the living state is pink, in the dry state light brownish yellow. The texture of the dry specimen is fragile and crumbling.

The sponge is lipostomous; wide canals are seen running outwards at right angles to the general surface of the sponge and terminating underneath networks on the margins of the ridges.

There are similar covered oscula on the inside of the cup. It thus appears that the oscula occur on the inside of the cup and on the ridges, but are hidden by a spicular network similar to that which covers the general surface of the sponge, only coarser.

The skeleton is a close irregular network of stout fibres composed of a great number of spicules loosely and irregularly bound together.

The spicules are slightly curved, ranging in form from

oxecote to strongylote; they vary much in size, especially in diameter, the average measurements of a full-grown spicule being about 0·37 by 0·0175 millim.

My examination of a very fine series of specimens in the British Museum has shown me that the spiculation of this species varies considerably; but I know of no tangible characters whereby the different varieties can be separated.

The specimen collected by Dr. Anderson in the Mergui Archipelago (fig. 2) resembles Mr. Thurston's specimen in texture and cup-like shape; but the surface-ridges are much more jagged and irregular and the spicules are rather larger.

Ridley's cup-shaped specimen from the 'Alert' collection differs in its thin walls, tougher texture, and small size, but agrees pretty well in spiculation.

Lamarek says of his specimen:—"Cet aleyon forme une plaque elliptique, un peu convexe en dessus, concave en dessous comme s'il s'étoit moulé sur le dos de quelque crabe, et rappelle la forme de la carapace supérieure d'une tortue." Probably his specimen was only a fragment of the side of a cup. The fragment in the British Museum, purporting to come from Lamarek's collection, agrees very well in general appearance with our present specimen, so far, of course, as can be judged from a small piece; the spicules measure 0·47 by 0·017 millim. and have well-rounded ends.

Reniera madrepora, n. sp. (Pl. IV. fig. 9.)

The single specimen in the collection is bushily ramose; it branches very freely, and the branches are short, subcylindrical or somewhat flattened, and often anastomose. The branching shows a decided tendency to become palmate and there is a short stout pedicel. The height of the specimen is 150 millim. and the greatest breadth a little more; the average diameter of the branches is about 8 millim. The oscula are small and scattered, chiefly on the inwardly-turned faces of the branches. The surface in the dry state is minutely hispid, the texture rather hard but brittle, and the colour dull orange. No record was kept of the colour in the living state.

The skeleton is arranged in the rectangular manner characteristic of the genus, with obvious distinction into primary and secondary fibres; but it is irregular, and, though dense, the spicules are loosely bound together and may occur scattered outside the true primary and secondary lines of the skeleton. In the centre of the branches the skeleton becomes

very dense and irregular and contains a large amount of spongin.

The spicules (fig. 9) are slightly curved oxea, tapering gradually to a sharp point at each end. Average size of full-grown spicule about 0.175 by 0.007 millim.

This species resembles most nearly Bowerbank's *Isodictya dichotoma**, but the growth is much more robust, the texture harder, the skeleton less regularly arranged, and the spicules longer than in that species, so that, taking into consideration the great difference in locality, I have thought it desirable to keep them separate.

Pachychalina multiformis, Lendenfeld, sp.,
var. *manaarensis*, nov.

1887. *Ceraochalina multiformis*, Lendenfeld, Zoologische Jahrbücher, Bd. ii. p. 783.

This variety is represented in the collection by fifteen dry specimens and two pieces in spirit. The sponge consists of erect, sessile, flattened lamellæ, with irregularly undulating and frequently proliferating surface. The colour of the living sponge was in one case pale violet and in another light pink; when dry it is greyish yellow, orange, or pale violet, and in spirit greyish yellow. The largest specimen is 250 millim. wide and 175 millim. high and the thickness of the lamellæ is about 5 millim. The texture of the dry specimens is tough and rather hard. The oscula are numerous and confined almost entirely to one surface of the lamellæ; they are about 1 millim. in diameter and they have slightly raised margins.

The dermal skeleton is a close network of relatively stout horny fibres, containing spicules for the most part uniserially arranged.

The main skeleton is a fairly regular rectangular network of stout horny fibres containing a great deal of spongin. The spicules are numerous in the primary fibres and few in the secondaries; they also occur outside the fibres.

The spicules are short slender oxea, straight or very slightly curved; the average size of a full-grown example is about 0.077 by 0.0036 millim.

The external form of this variety is characteristic and fairly constant. Six dry specimens of it also occur in Mr. Thurston's first collection, but are not mentioned in my Report; three of these are of a violet colour, and the other three are of

* Mon. Brit. Spong. vol. ii. p. 309, vol. iii. pl. liii. figs. 12-14.

a greyish-yellow colour. They exhibit a more strongly marked tendency to form digitate processes than do the specimens in the second collection.

Pachychalina delicatula, n. sp.

Sponge erect, sessile, bushily lamellar, with a slight tendency to throw off digitate processes. Very delicate in appearance. Surface smooth, covered by a very delicate dermal membrane. Texture open, resilient. Colour in the dry state light yellow. Oscula situated chiefly on the margins of the lamellæ. The single specimen in the collection is 180 millim. high and 220 millim. in greatest breadth. The lamellæ measure up to 21 millim. in thickness at the margin, but usually much less. The oscula average about 3 millim. in diameter.

The dermal skeleton is a close-meshed irregular reticulation of slender horny fibre containing very slender spicules arranged sometimes uniserially and sometimes multiserially. The main skeleton is a wide-meshed reticulation of very stout primary and secondary fibres. Both primary and secondary fibres are composed of a very great number of slender spicules packed close together all through the fibre and united by spongin. Both primary and secondary fibres average about 0.126 millim. in diameter. The wide interspaces between them are partially occupied by an irregular network of very much slenderer polyspiculous fibres* about 0.0175 millim. in diameter, branching and anastomosing freely with each other and with the primaries and secondaries. Numerous spicules occur scattered outside the fibres.

The spicules are very slender slightly curved oxea, measuring about 0.098 by 0.0035 millim.

Pachychalina spinilamella, n. sp.

Sponge consisting of erect, flattened, frondose or digitate thick lamellæ. Both surfaces of the lamellæ are covered with numerous short stout spines. The largest specimen is attached to a mass of nullipore; it is 160 millim. high and 185 millim. broad, while the thickness of the lamellæ is about 13 millim. (Another specimen consists of a short stalk about 47 millim. high and 20 millim. in diameter, dividing into two upright flattened branches, one of which is hollow, penetrated by a wide, vertical, oscular tube; total height of

* For the sake of convenience these fibres may be termed "tertiary."

specimen 135 millim.) The oscula are rather large, commonly about 4 millim. in diameter in well-grown specimens; they occur on one surface only of the lamellæ and sometimes round the margin. The dermal membrane is distinct, with a well-developed reticulation of spiculo-fibre.

The colour in life was pale yellow; when dry it is brownish yellow, and the same colour, only darker, in spirit. Texture in the dry state tough and hard, but rather open. When the sponge is held up to the light stout primary skeleton-fibres are seen ramifying upwards in a dendritic manner and terminating in the conuli on the surface.

The dermal skeleton is a quite irregular network of very stout fibres, containing a great number of closely packed spicules whose meshes are subdivided by an irregular network of very slender fibres both uni- and multispiculous.

The main skeleton is also irregular and composed of very stout primary fibres about 0.18 millim. in diameter, rather slenderer secondaries and slender tertiaries, about 0.015 millim. in diameter. All the fibres contain a very great number of spicules, closely packed side by side, and occupying almost the whole thickness of the fibre; but there is plenty of spongin uniting them together. Spicules are abundantly scattered about outside as well as in the fibres.

The spicules are relatively long, very slender oxea, usually slightly curved, measuring about 0.126 by 0.0017 millim. They are gradually and sharply pointed at each end.

There are in the collection four dry specimens of this sponge and a piece in spirit.

Siphonochalina communis, Carter, sp.

1881. *Tubulodigitus communis*, Carter, Ann. & Mag. Nat. Hist. ser. 5, vol. vii, p. 367.

With this species I identify a single fine specimen attached to a fragment of rock, to which is also attached a small specimen of *Hircinia clathrata*. The sponge consists of a thin incrusting basal mass, spreading over the surface of the rock and throwing out abundant short, upright, tubular processes, each terminating in a single osculum. The tubes reach some 70 millim. in maximum height and the oscula average about 4 millim. in diameter. The tubes anastomose freely with one another and also branch to some extent; they average about 5 or 6 millim. in diameter.

The colour in life was bluish brown; in spirit it is yellowish brown, and when dry the same with a decidedly purplish

tinge. The texture in the dry state is stiff and resilient, but very brittle.

The dermal skeleton is a delicate close-meshed network of relatively stout horny fibre cored by uniserially arranged slender spicules.

The main skeleton is composed of stout primary and secondary fibres arranged rectangularly and fairly regularly, cored by slender spicules arranged uniserially in the secondary fibres and either uni- or multiseri ally in the primaries. Spicules also occur plentifully scattered outside the fibres.

The spicules are slender, very slightly curved oxea, gradually sharp-pointed at the ends, measuring when full-grown about 0.126 by 0.0047 millim.

Mr. Carter gives no generic diagnosis of *Tubulodigitus*, and the species falls very well under *Siphonochalina* as at present understood. His specimens also came from the Gulf of Manaar.

Siphonochalina crassifibra, n. sp.

The single specimen in the collection consists of four tubes arising from a common base. Three of them grow up side by side in the same plane, while the fourth, which is smaller, lies in a different plane, either in front of or behind the other three, according to the point of view. There are evident traces of the existence, in the living sponge, of a fifth tube, which has been taken off and preserved in spirit. The tubes are subcylindrical, but slightly compressed in one plane, and they are constricted occasionally at irregular intervals. Each tube has a large oscular opening at the top. The total height of the specimen is 150 millim., the diameter of the tubes about 25 millim., and the thickness of the tube-wall about 7 or 8 millim., but variable. The surface of the tubes, owing to the projection of the ends of the stout primary fibres, is coarsely granular. It has also a reticulate appearance, due to the arrangement of the dermal skeleton. The colour of the living sponge was deep blue, in spirit and in the dry state it is brown, in the dry state with a decided tinge of purple. The texture is coarsely fibrous, resilient.

The dermal skeleton is an irregular network of coarse fibre, whose meshes are broken up by an equally irregular network of fine fibre. Both sets of fibres contain numerous spicules and an abundance of spongin; the spicules are rather loosely scattered through the fibre, but usually more numerous in the axis than towards the periphery; sometimes also they are

placed more or less at right angles to the long axis of the fibre, so as to echinate it, usually in irregular groups.

The main skeleton is a rectangular network of stout primary and secondary fibres, the primaries measuring about 0.14 and the secondaries about 0.084 millim. in diameter. Both primaries and secondaries consist of a large amount of clear transparent spongin, with an axial core of slender spicules multiseriably arranged. The spicules are numerous in both sets of fibres, but more so in the primaries than in the secondaries. Numerous spicules occur scattered outside the fibres.

The spicules are slightly curved, slender oxea, gradually sharp-pointed at each end, measuring about 0.084 by 0.0035 millim.

Gelliodes carnosus, n. sp. (Pl. IV. fig. 7.)

Sponge erect, sessile, more or less lamellar, proliferous; sometimes rising into short tubular processes. The arrangement of the oscula and oscular tubes gives to the sponge a very characteristic appearance. The oscula are very numerous and occur chiefly on the margins of the sponge, but also on isolated papillæ. They average 2 to 3 millim. in diameter and lead into long, narrow, vertical oscular tubes. The presence of these tubes causes the surface of the lamellæ in which they lie to be more or less ribbed vertically, so that the course of an oscular tube can be traced for some distance by means of the rounded ribs on the surface. The largest specimen is 180 millim. high by 200 millim. broad. The thickness of the actual lamellæ is about 6 or 7 millim.

The colour in the living state was grey and it is also brownish grey when dry. The surface is smooth but uneven, with rather a fleshy appearance; in spirit it appears glabrous. The texture is tough and resilient.

The skeleton is very strongly developed, composed of a very close, more or less regularly rectangular reticulation of unusually stout horny fibre. The primary lines have a multispicular core of oxeote spicules, while the secondaries have fewer spicules. In some parts the arrangement of the skeleton becomes less regular, but it is throughout characterized by a very strong development of spongin.

Spicules.—(a). Megasclera:—Small, usually slightly curved, gradually sharp-pointed oxea (fig. 7, a, b), measuring about 0.126 by 0.006 millim.

(b). Microsclera:—Very small and very slender sigmata (fig. 7, c), about 0.017 millim. long; visible after soaking

for some time in Canada balsam, when they appear abundantly.

This is a well-marked species with a very characteristic external form; there are five dry specimens of it in the collection, so that it would appear to be plentiful.

Iotrochota baculifera, Ridley, var. *flabellata*, Dendy *.

There are in the collection a single very fine dry specimen of this variety and two small pieces preserved in spirit. The dry specimen is shaped like the leaf of a Spanish chestnut, consisting of a single flattened frond which has grown up around the stem of some plant for an axis. It is 325 millim. in height and 130 millim. in greatest breadth; the thickness is variable, up to about 10 millim. along the margin, but much more in the centre. On either surface of the flattened frond irregular proliferations are given off. A noteworthy feature of this specimen is the presence of grooves on both surfaces of the sponge radiating towards the margin in an outward and upward direction, like the veins of a Spanish-chestnut leaf. Both dry and spirit specimens contain a large quantity of sand. The colour of the living sponge was black, when dry or in spirit it is dark purple. The texture when dry is very fragile, the sponge crumbling up between the fingers like a *Dysidea*; in spirit, however, it is fairly tough.

The specimen may possibly have grown erect; but from the difference in shade of colour between the two sides and from the somewhat worn appearance of the lighter one I am inclined to think that the latter was lowermost during life.

The oscula are rather small and occur chiefly along the margin.

Clathria indica, n. sp. (Pl. IV. fig. 10.)

Sponge erect, flabellate, consisting of a number of flattened, branching, and anastomosing trabeculae, fused together so as to form a more or less continuous frond; sometimes growing out into free digitate processes. Texture in the dry state coarse and hard, fibrous and tough, in spirit softer. Colour of the living sponge bright red, when dry or in spirit yellowish brown. The oscula are apparently represented by very numerous minute openings thickly strewn over both

* For references *vide* Dendy, Ann. & Mag. Nat. Hist. ser. 5, vol. xx. p. 158.

surfaces of the sponge. An average-sized well-grown specimen measures about 180 millim. in height by 280 millim. in breadth, and the thickness of the trabeculæ of which it is composed is about 4 millim. Sometimes, however, the sponge is taller than it is broad.

The skeleton is a very well-developed close-meshed network of stout horny fibres echinated by spined styli. The distinction between primary and secondary lines is not always very well marked, and the reticulation tends to become very irregular; the primary fibres, however, are more abundantly echinated than the secondaries and they have also numerous spined styli in the axis of the fibre, which are absent from the secondaries.

The primary fibres measure about 0.07 millim. in diameter, but sometimes more and sometimes less, and the secondaries somewhat less.

Spicules.—The megasclera (fig. 10) are of two kinds:—(1) Smooth slender styli (verging upon the tylostylote form) or unequal-ended oxea, straight or slightly crooked, measuring about 0.14 by 0.003 millim., occurring abundantly scattered in the dermal membrane, but only sparingly in the choanosome. (2) Small, straight, entirely spined styli, gradually and sharply pointed at the apex, and frequently narrowing somewhat at the base; size about 0.084 by 0.007 millim.

I can find no microsclera, although I have searched very carefully for them, and this species therefore appears to be one of those aberrant members of the genus which are devoid of microsclera. The species appears to be abundant, being represented in the collection by eight dry specimens and a piece in spirit.

Clathria corallitincta, n. sp. (Pl. IV. fig. 8.)

Sponge sessile, usually lamellar, but proliferous. Consisting of a close reticulation of small, branching and anastomosing, irregularly cylindrical or flattened trabeculæ, ramifying upwards and terminating on the surface of the sponge in short obtuse processes. The largest specimen is 265 millim. broad by 131 millim. high. The diameter of the separate trabeculæ of which the sponge is composed averages about 2–3 millim. Texture in the dry state rather hard and brittle, in spirit tough, resilient. The living sponge was “red-coral” coloured; in spirit it is yellowish grey, and when dry the same, with tinges of red here and there.

The reticulate or clathrous character of the sponge is not so well marked in spirit as in the dry condition, the fenestra-

tions being frequently filled up by delicate membranous tissue.

The arrangement of the horny skeleton agrees very well with that in *Clathria indica*, but the spicular element is more strongly developed, though scarcely at the expense of the horny fibre. There are an abundance of smooth styli enclosed in the primary lines of the skeleton.

Spicules.—(a). Megasclera:—(1) Smooth styli (fig. 8, a, b, c), straight or slightly curved, gradually sharp-pointed, and of two principal sizes—(a) stout and relatively short, averaging about 0.175 by 0.008 millim., abundant and occurring principally in the choanosome; (β) long and slender, sometimes becoming slightly tylostylote, averaging about 0.22 by 0.005 millim., occurring principally in the dermal membrane. (2) The echinating spicules (fig. 8, d); these are short and relatively stout spined tylostyli, gradually and very sharply pointed at the apex, and narrowing somewhat towards the base, which is commonly expanded into a slight head; the spines are scarce or absent for a short distance above the base; size of spicule about 0.056 by 0.006 millim.

(b). Microsclera:—A few very minute slender isochelæ of the usual *Clathria* type, about 0.014 millim. long. In an embryo enclosed in the sponge there are also some small and exceedingly slender toxa, and it is not unlikely that such may also exist in the adult sponge, where they might escape detection amongst the mass of larger spicules.

This species is represented in the collection by five specimens and a piece in spirit.

Rhaphidophylus spiculosus, n. sp. (Pl. IV. fig. 4.)

There is in the collection a single dry specimen and a piece in spirit. The dry specimen forms a flattened clathrous mass of branching and anastomosing flattened trabeculæ*. It seems to be a good deal shrunk up and measures in its present condition 108 millim. in length and 72 millim. in breadth, while the thickness of the trabeculæ averages about 5 millim. It is impossible to say whether the species is erect or decumbent in life.

The colour of the living sponge was vermilion; when dry it is light brownish yellow, with occasional red tinges, and in spirit it is darker greyish yellow.

The texture in spirit is compact and cork-like. The oscula are minute and scattered, mostly on or near the margins of

* That this flattening is normal is shown by the spirit specimen.

the flattened trabeculæ. The surface of the sponge is very uneven, subglabrous in appearance in spirit, rough in the dry condition.

The main skeleton is a dense irregular reticulation of stout horny fibres, with rounded meshes. The fibres are about 0.1 millim. in diameter, but variable; they are abundantly but irregularly cored by long slender tylostyli and sparsely echinated by short spined tylostyli. Between the fibres of the skeleton the long slender tylostyli are very thickly but irregularly scattered through the soft tissues.

The dermal skeleton is well developed and consists of dense, close-set, radiating brushes of long slender tylostyli with their points projecting outwards.

Spicules.—(a). *Megasclera*:—(1) Long, straight, very slender tylostyli (fig. 4, *a, b, c*), sharply and gradually pointed at the apex, and with small oval heads at the base, which is sometimes very minutely spined; size of full-grown examples about 0.294 by 0.005 millim. (2) Short, stout, spined, echinating tylostyli (fig. 4, *d, e*), with rounded heads and very sharp points; the spines are arranged so as to leave the apex and a space immediately above the head free; average size of spicule about 0.07 by 0.007 millim.

(b). *Microsclera*:—(1) Very minute isochelæ of the usual *Clathria* type, about 0.014 millim. long. (2) Very small, slender, apparently smooth toxa, about 0.056 millim. long.

Hymeniacidon (?) *fætida*, n. sp. (Pl. IV. fig. 5.)

Sponge massive, sessile, slightly lobose. The single specimen in the collection measures 143 millim. in greatest breadth and 60 millim. in height. The oscula are of fair size and situate on the summits of the low lobes. Surface very distinctly reticulate. Texture in the dry state hard and incompressible, in spirit a little softer. Colour of the living sponge grey; when dry or in spirit the colour is dull blackish grey on the outside and lighter internally.

The main skeleton is a very dense irregular reticulation of large oxea, sometimes aggregated in thick strands or fibres; the spongin is very feebly, if at all, developed. The dermal skeleton is a very close reticulation of stout bands of spicules. The meshes of the reticulation are very small and rounded, and the bands of spicules dividing them are irregular, but so strongly developed as to cover a greater superficial area than the actual meshes. The dermal, like the main skeleton, is composed principally of large oxea, but there are also present

a few small styli arranged with their apices projecting at the surface of the sponge.

Spicules.—(1) Large, curved, gradually sharp-pointed oxea (fig. 5, *b*), measuring about 0·8 by 0·021 millim. (2) Small, slightly curved, smooth styli (fig. 5, *a*), evenly rounded off at the base and gradually sharp-pointed at the apex; commonly narrowing somewhat towards the base; size about 0·2 by 0·007 millim.

The specific name *fortida* has been given to this sponge on account of the abominable smell, resembling somewhat the smell of Valerian, given out by the dry specimen.

The presence of the small projecting styli in the dermal skeleton recalls the similar condition described by Ridley and Dendy in *Hymeniacidon* (?) *subacerata* *.

Axinella labyrinthica, n. sp. (Pl. V. fig. 12.)

Sponge forming sessile, low-growing, erect, branching and anastomosing lamellæ. Surface uniformly covered with small, close-set, rather slender conuli, each about 2 millim. in height. Colour of the living sponge bright orange; when dry or in spirit yellowish. Texture (dry and in spirit) rather hard and fairly tough. Oscula minute, abundantly scattered between the conuli. The single specimen is 71 millim. in height and 200 millim. in greatest breadth; the thickness of the lamellæ is about 9 millim., including the conuli.

The skeleton is an exceedingly dense irregular network of spicules, in which it is very difficult to make out any distinct fibres; but stout columns of closely aggregated spicules may be seen running one into each of the surface conuli. The surface of the conuli is densely echinated by projecting spicules springing from these columns. We may imagine the whole skeleton derived from a typical axinellid form by excessive development of the spicules, which are closely united together.

Spicules.—(1) Smooth styli (fig. 12, *b*, *c*), usually more or less bent, especially towards the base, and gradually sharp-pointed at the apex; size usually about 0·42 by 0·016 millim. (2) Slender curved strongyla (fig. 12, *a*), as long as or somewhat longer than the styli, but slenderer.

This is a very beautiful species, with a well-marked and characteristic external form.

* *Vide* Report on the 'Challenger' Monaxonida, p. 169.

Axinella Donnani, Bowerbank *.

There are six dry specimens of this sponge in the collection and also two pieces in spirit. I have nothing further to add to the accounts given by Bowerbank and myself, excepting that Mr. Thurston again records the colour of the living sponge as orange.

Axinella tubulata, Bowerbank, sp. (Pl. V. fig. 11.)

1873. *Haliphysema tubulatum*, Bowerbank, Proc. Zool. Soc. Lond.

1873, p. 29, pl. vii.

1878. *Aulospongius tubulatus*, Norman, Ann. & Mag. Nat. Hist. ser. 5, vol. i. p. 267.

This species is evidently very abundant in the Gulf of Manaar, being represented in the collection by six dry specimens and two pieces in spirit.

The sponge is massive and usually globular or subglobular in shape. The largest specimen in the collection, which is irregularly massive in form and rounded, is 105 millim. in height and 97 millim. in breadth. All the specimens have more or less flattened bases and appear to have been attached during life, and not, as Bowerbank surmised, freely floating. The surface of all the specimens is covered with small conical papillæ whose size varies considerably in different specimens. Thus in one specimen they are comparatively large and isolated from one another, while in another they are small and run into one another in a mæandriniform manner. The colour of the living sponge was pinkish red or red; in the dry state it is orange and in spirit pale yellow. The oscula are small and scattered and sometimes slightly prominent. There is a dermal membrane connecting together the surface conuli at a little distance below their summits. The texture is firm and hard in the dry state and softer in spirit.

The skeleton is composed of stout, irregular, branching columns, radiating towards the surface and terminating in the conuli. Each column is composed of various sizes of stylote and tylostylote spicules, arranged in the usual echinating manner characteristic of the Axinellids, with their points projecting obliquely outwards and towards the surface of the sponge and their bases usually united together by spongin. Numerous spicules also occur scattered through the soft tissues of the sponge which cannot be assigned to any particular

* For references &c. *vide* Dendy, Ann. & Mag. Nat. Hist. ser. 5, vol. xx. p. 158.

column, and it will be evident from the figure (fig. 11) that the columns are not very well-defined structures.

Spicules.—These are of two kinds:—(1) Large smooth styli, more or less curved, especially towards the well-rounded base, which is sometimes slightly swollen; gradually sharp-pointed at the apex; size when fully developed about 0.38 by 0.014 millim. (2) Small tylostyli, straight or bent near the base; with small subglobular heads and very gradually sharp-pointed at the apex; usually more or less covered with minute spines, which appear, however, to be always absent from the base. These spicules when full-grown average in size about 0.119 by 0.004 millim., the diameter being measured just above the head. It is unnecessary to give figures of these spicules, as this has already been done by Dr. Bowerbank (*loc. cit.*).

This sponge is remarkable for the presence in all specimens of numerous commensal worms. The worms are very small tubicolous Oligochaetes. Their tubes (fig. 11, *a, b, c*) are very slender, averaging about 0.3 millim. in diameter, and they radiate towards the surface of the sponge, opening about at the level of the dermal membrane, in which they appear as minute circular pits easily visible when the surface of the sponge is examined with a hand-lens. Sometimes the margins of the tubes are a little raised, and the tubes usually appear close to the sides of the radiating skeleton columns. Fig. 11 shows portions of three of the worm-tubes, one of them (*a*) opening close to a surface-papilla and still containing the worm. The tubes sometimes branch; but whether or not the worm likewise does so I have been unable to determine. It is very possible that the presence of these commensal worms has a good deal to do with the characteristic globular shape of the sponge, and one might almost regard the whole structure as a spherical mass of radiately arranged tubicolous worms in which the interstices between the individual tubes are occupied by a sponge. It would be interesting to know whether the worm and the sponge ever live separately or are always associated together.

The worm-tubes are also present in Dr. Bowerbank's type of the species, of which I made a careful examination in the British Museum; but he laboured under a curious mistake as to their true nature, regarding them as a tubular skeleton proper to the sponge. This mistaken idea led him to give a most remarkable account of the species, for which I would refer the reader to his original paper*, as I have not space to quote it in this place.

* *Loc. cit.*

Dr. Norman was misled by Bowerbank's account; and while he shows that the species cannot be assigned to the genus *Haliphysema*, he proposes for it the new generic name *Aulospongos* *. It is unnecessary, however, to erect a new genus for the reception of this sponge, which falls very well under *Axinella*.

We have here one of the most remarkable cases of commensalism known amongst sponges.

Ciocalypta Tyleri, Bowerbank, var. *manaarensis*, nov.

1873. *Ciocalypta Tyleri*, Bowerbank, Proc. Zool. Soc. Lond. p. 21, pl. iv. figs. 9-12.

Of this variety there are in the collection two good dry specimens and one of the digitate processes preserved in spirit. The external form of the specimens closely resembles Dr. Bowerbank's figure. The surface of the digitate processes is much corrugated. The colour in the living state was white, and it is also dirty yellowish white in the dry state and in spirit. The taller of the two specimens is 55 millim. high and 47 millim. in diameter at the base, which is approximately circular; it bears about a dozen digitate processes, springing from the cushion-shaped base, and sometimes anastomosing, but never branching. The digitate processes are about 8 millim. in diameter at the base.

The skeleton is arranged as usual in the genus, with a dense central axis, from which arise short columns supporting the dermal membrane at their outer ends.

Spicules.—Slightly curved and very gradually and sharply pointed oxea, resembling those of *Halichondria panicea*; occasionally an odd stylote form may be observed amongst the larger ones. They vary very greatly in size; in the dermal membrane they are small and slender, measuring as a rule about 0.3 by 0.007 millim., but with a wide range of variation, though never attaining to nearly the dimensions of those in the central axis; in the axis also they vary greatly, measuring up to about 1.25 by 0.024 millim., though this extreme size appears to be reached only rarely, the average size of the full-grown spicule being about 0.8 by 0.011 millim.

This variety differs from the types of the species in the presence of the very large oxea in the central axis.

The species has hitherto been obtained from Port Eliza-

* *Loc. cit.*

beth*, South Australia†, and the east coast of Australia‡.

Auletta aurantiaca, n. sp. (Pl. V. fig. 13.)

Sponge bushy, composed of short, branching and anastomosing, thick-walled tubes, frequently united laterally so as to form lamellæ, like pan-pipes. Each tube is open at the top. The largest specimen is 95 millim. high and 105 millim. in diameter; the tubes are pretty constant in diameter, averaging about 6 millim. The surface is minutely hispid both when dry and in spirit. The texture in the dry state is hard and firm, in spirit softer. The colour of the living sponge was bright orange; in the dry state it varies from pale yellow to bright orange, in spirit it is greyish yellow.

The skeleton is very loose and irregular, consisting of stylote and oxeote spicules arranged partly in loose irregular wisps, which run upwards and outwards and terminate in projecting brushes at the surface of the sponge. These represent the primary lines of the skeleton; they are sometimes crossed more or less at right angles by individual spicules or by two or three together, which represent the secondary lines. The whole skeleton is, however, very confused, and spicules occur abundantly scattered through the choanosome which cannot be referred to either primary or secondary skeleton lines. There is a fair amount of spongin present.

Spicules.—These are of two kinds:—(1) More or less curved oxea (fig. 13, *c*, *e*), gradually sharp-pointed at each end, measuring about 0.28 by 0.011 millim., not nearly so abundant as the following. (2) Long, slender, very gradually sharp-pointed styli (fig. 13, *a*, *b*, *d*), generally more or less curved or bent. As usual in the Axinellidæ these spicules vary greatly both in actual size and in proportion of length to thickness; they are usually somewhat larger than the oxea, but sometimes extremely long and slender, measuring up to about 0.8 millim. in length.

There are four specimens of this very pretty species in the collection and also a piece in spirit.

The genus *Auletta* was founded by Schmidt§ for his

* Bowerbank, *loc. cit.*

† Carter, Ann. & Mag. Nat. Hist. ser. 5, vol. xvi. p. 366.

‡ Lendenfeld collection in British Museum.

§ 'Grundzüge einer Spongien-Fauna des atlantischen Gebietes,' p. 45.

Auletta sycinularia, but he gives no diagnosis. Vosmaer places the genus near *Chalina* and describes a new species under the name *Auletta elegans**, which certainly seems to belong to the genus. In his work on the Porifera in Bronn's 'Klassen und Ordnungen des Thierreichs' † he diagnoses the genus as follows:—"Einzelne 'Person,' oder Stock von röhrenförmigen 'Personen.' Skelet besteht aus Bündeln von Spicula, welche vorzüglich in der Längsrichtung verlaufen. Spic. indic. *ac.*² und *tr. ac.* Canal-System unbekannt."

The genus appears to be truly Axinellid ‡, and may be briefly diagnosed as follows:—"Tubular Axinellidæ. Skeleton reticulare. Megasclera monactinal and (sometimes at any rate) also diactinal."

Hitherto the genus has been obtained only from the Atlantic and Arctic Oceans, so that its range is very greatly extended by Mr. Thurston's investigations.

Acanthella Carteri, n. sp. (Pl. IV. fig. 6.)

Sponge erect, but not stipitate, lamellar. Lamellæ thin, irregular, proliferously branching, with sinuous margins. Both surfaces of the lamellæ are covered with short, stout, conical spines and ridges, especially prominent in the dry condition. The largest specimen is 130 millim. high by about 180 millim. broad, and the lamellæ of which it is composed average about 2.5 millim. in thickness in the dry state, excluding the spines and ridges. The texture in the dry state is hard and fairly tough, in spirit it is softer and tougher. The colour of the living sponge was orange-red; in the dry state it is dull reddish orange, and in spirit greyish yellow.

The skeleton is a very irregular network of stylote spicules, extremely dense in certain parts of the sponge, but absent or almost absent in others. There are no definite fibres and these are probably represented by certain denser spicular tracts, in which occasionally traces of the typical Axinellid arrangement of the spicules may be observed.

Spicules.—Styli of two chief forms:—(a) Short, stout, more or less bent, gradually sharp-pointed at the apex, and evenly rounded off at the base (fig. 6, *b, c*); size about 0.4 by 0.021 millim. (b) A comparatively small number of very long and very slender slightly curved styli (fig. 6, *e*), evenly

* Report on Sponges dredged up in the Arctic Sea by the 'Willem Barents' in the years 1878 and 1879, p. 40.

† P. 341.

‡ Cf. Ridley and Dendy, Report on the 'Challenger' Monaxonida, p. 187.

rounded off at the base (or becoming tylostylote), and very gradually sharp-pointed at the apex; size when full-grown about 1.2 by 0.011 millim. There are also a few cylindrical forms (strongyla) (fig. 6, *d*) and still fewer oxea (fig. 6, *a*); but these are probably only abnormal developments of the short stout styli such as are frequently found in Axinellids.

There are three dry specimens of this sponge and a piece in spirit.

CERATOSA.

Spongionella nigra, n. sp.

Sponge sessile, consisting of a number of vertical lamellæ, branching and anastomosing with one another often in a very complex manner. The largest of the four dry specimens is about 250 millim. high and the same in breadth, and the thickness of the lamellæ is about 5 millim. The colour of the living sponge is black, when dry dull black, and in spirit rather lighter blackish grey. Texture tough and resilient. Surface (dry and in spirit) granulated. The oscula are abundantly scattered, usually on the inwardly turned surfaces of the lamellæ, and almost or quite confined to one surface of each lamella; they are about 1-2 millim. in diameter and are compound, each consisting of an aggregation of several smaller ones.

The dermal skeleton is a well-developed but irregular network of horny fibre with fairly wide polygonal meshes; the fibres averaging about 0.02 millim. in diameter.

The main skeleton is a rectangularly meshed network of very distinct primary and secondary fibres; the primary fibres average about 0.049 millim. in diameter and the secondaries about half as much.

All the fibres of the skeleton are composed of pale-coloured spongin without any trace of foreign enclosures. The fibres are solid, and it is difficult to make out any distinct central granular core, though possibly such may exist, at any rate in some cases.

The ectosome is represented by the thin dermal membrane. The choanosome is very delicate and gelatinous, containing a large number of amœboid and stellate cells. The canal-system is eminently lacunar and the lacunæ are very strongly developed. The flagellated chambers are irregularly sac-shaped and they vary much in size, the full-grown chambers averaging about 0.07 millim. in diameter. They are not placed very close together and lie irregularly scattered through

the choanosome, so as to leave frequent wide interspaces devoid of chambers. They open directly into the excurrent lacunæ.

This is a very remarkable and interesting species, one of the most striking features of which is the large size of the flagellated chambers. These chambers are conspicuous objects even in unstained, hand-cut, rough preparations of ordinary spirit material.

The genus was founded by Bowerbank for his *Spongionella pulchella*, a British species*, and he afterwards described† another species, *S. Holdsworthii*, from the Ceylon Pearl Banks. All his specimens of the genus appear to have been dry, and I am now able, from my examination of the spirit-preserved material sent by Mr. Thurston, to amend his original diagnosis as follows:—"Genus *Spongionella*, Bowerbank. Sponge consisting of flattened lamellæ. Main skeleton of very distinct primary and secondary fibres without foreign enclosures, arranged so as to leave rectangular meshes. Ectosome a thin dermal membrane. Choanosome extremely delicate, transparent and gelatinous. Canal-system lacunar. Flagellated chambers very large, irregularly sac-shaped, opening directly into the excurrent lacunæ."

The genus possibly finds its nearest ally in *Spongelia*, and would fall under Lendenfeld's subfamily Spongeliinæ‡. It presents, however, very striking resemblances to the Chalininæ. These resemblances are most apparent in the general external form and in the structure and arrangement of the horny fibres (except of course as regards the total absence of spicules). The histological character of the choanosome also agrees with that found in Chalininæ§; but the flagellated chambers are very much larger, and this would appear to be an important distinction||.

According to Vosmaer¶ Bowerbank's *Spongionella* is synonymous with Schmidt's *Cacospongia*. This is a difficult question, and in order to settle it we require a much more extensive knowledge of the anatomy of these forms. According to Lendenfeld** *Cacospongia* is one of those forms

* *Vide* Mon. Brit. Spong. vol. i. pl. xxxvii. fig. 380, vol. ii. pp. 12, 359, vol. iii. pl. lxxv.

† Proc. Zool. Soc. Lond. 1873, p. 25.

‡ *Vide* Proc. Zool. Soc. Lond. 1886, p. 589.

§ *Vide* Lendenfeld, 'Zoologische Jahrbücher,' Band ii. p. 734.

|| *Vide* Lendenfeld, *loc. cit.*; also Dendy, Proc. Zool. Soc. Lond. 1887, p. 526.

¶ "Porifera," in Bronn's Klass. und Ordnung. des Thierreichs, p. 364.

** Proc. Zool. Soc. Lond. 1886, p. 587.

which have "small, spherical, ciliated chambers and opaque ground-substance," and therefore it differs greatly from *Spongionella nigra*; but whether Dr. Bowerbank's two species of *Spongionella* agree in these respects with *Cacospongia* or with *Spongionella nigra* is at present undeterminable. As I cannot place my species under *Cacospongia*, I think it better to retain Dr. Bowerbank's *Spongionella* with emended diagnosis in preference to creating a new genus.

Hircinia clathrata, Carter*.

This common Ceylon species is represented in the collection by two good specimens; unfortunately, however, there is no piece in spirit. One of the two specimens is remarkable on account of its large size and luxuriant growth; it measures 280 millim. in height and 250 millim. in greatest breadth. The other specimen, although smaller, is of great value in that it exhibits certain features not hitherto observed in the species. The specimen has been dried with the soft tissues on, and instead of being of the usual dull yellow colour, it has a distinctly purple tinge. In his original description of the species Mr. Carter suggested that "the sarcode of *H. clathrata* may have been so coloured," but he was unable to show that it was so from the material at his disposal†. The particular specimen referred to also shows that the wide irregular openings on the surface of the sponge, which lead into the central cavity of the tubular branches, are normally tympanized by a delicate translucent membrane, pierced in places by rounded apertures resembling oscula.

For the geographical distribution of this species the reader is referred to my previous paper‡. I may add that there is in the collection of the British Museum a specimen§ of a slight variety of the species from North-western Australia. This Australian variety differs from the Manaar specimens chiefly in the larger quantity of foreign matter present in the primary fibres.

Hircinia (?) sp.

There are in the collection some pieces of a sponge which

* For references *vide* Dendy, Ann. & Mag. Nat. Hist. ser. 5, vol. xx. p. 163.

† There is, however, a small specimen of *Hircinia clathrata* attached to the same stone as the specimen of *Siphonochalina communis*, and Mr. Thurston says that the colour of this small specimen in life was reddish brown.

‡ *Loc. cit.*

§ Registered 83. 2. 22. 19.

I refer provisionally to the genus *Hircinia*. They consist of branched digitate processes about 15 millim. in diameter, with strongly and regularly conulose surface. Colour of the living sponge blackish grey, in the dry state almost black, and in spirit dark grey. Texture in the dry state hard and incompressible, in spirit softer, compact, cork-like. In external appearance this species bears a most striking resemblance to a specimen of Schmidt's *Hircinia dendroides* * in the British Museum. I have found the characteristic "filaments" only in one place.

Aplysina purpurea, Carter.

1880. *Aplysina purpurea*, Carter, Ann. & Mag. Nat. Hist. ser. 5, vol. vi. p. 36.

1881. *Aplysina purpurea*, Carter, Ann. & Mag. Nat. Hist. ser. 5, vol. viii. p. 103, pl. ix. figs. 1, *a-i*, and 2, *a-c*.

The single dry specimen in the collection is conical in form, slightly flattened in one plane, with broad base and bluntly rounded apex. It measures 195 millim. in height and the greatest breadth of the base is about 110 millim.

The colour in the living state was grey; when dry it is a black-purple and in spirit a little lighter purple. The surface of the dry sponge is thickly covered with large conical projections, due to the ends of the stout compound skeleton-fibres supporting the dermal membrane in a tent-like fashion. The dermal membrane is shrunk in between the projections, which are probably more prominent in dry specimens than in life; it exhibits only occasionally the minute reticulation mentioned by Mr. Carter.

The oscula vary in size and are irregularly scattered over the surface of the sponge; it is a rather curious fact that they are not more numerous at the apex of the sponge than elsewhere. Sometimes they are fairly large and single and sometimes they are small and grouped.

The structure of the dry sponge internally is very cavernous; the texture of the pieces in spirit is compact and cork-like.

The skeleton, as already described and figured by Mr. Carter, is composed of compound fibres. These compound fibres are, however, merely dense local aggregations of branching and anastomosing horny fibres accumulated along certain tracts so as to leave the remainder of the sponge free from skeletal elements. That this is the case appears from

* Registered 67. 7. 26. 79.

the fact that flagellated chambers occur scattered between the individual fibres in a compound fibre.

The compound fibres are very stout and very widely separated from one another, terminating in the surface conuli. Each compound fibre may be as much as 2 millim. in diameter in the dry condition.

Mr. Carter's first description of this species was very imperfect; the specimen upon which it was founded came from the Gulf of Manaar. His second description, founded on a specimen from Ceylon and one from Australia, leaves no doubt in my mind as to the correctness of my identification; but I think it very probable that the Australian specimen described by Mr. Carter belongs to a different species.

Aplysina fusca, Carter.

1880. *Aplysina fusca*, Carter, Ann. & Mag. Nat. Hist. ser. 5, vol. vi. p. 36 (*vide* also ser. 5, vol. viii. p. 107).

I refer three dry specimens present in the collection to this species. They are necessarily lobate or digitate, and the surface is beset with abundant small, sharp, conical eminences, between which the dermal membrane is shrunk down. The surface is glabrous or subglabrous, and the texture in the dry state is very hard and incompressible, membranous. Colour in the dry state dark brown. The largest specimen is 195 millim. high by about 160 millim. in greatest breadth. Two of the specimens are cavernous internally, while the third appears to be much more solid; I do not think, however, that there is any specific difference between them.

I have very little doubt that this is Mr. Carter's *Aplysina fusca* (especially as the type of the species came from the Gulf of Manaar), although I have not had the opportunity of studying the type, and the original description is too short to make an identification as reliable as might be desired. In Mr. Carter's second account of the species* very little is added to the first.

EXPLANATION OF THE PLATES.

PLATE III.

Fig. 1. Petrosia testudinaria, from the neighbourhood of the Tuticorin Pearl Banks. Collected by Mr. Thurston.

Fig. 2. Petrosia testudinaria, from Padau Bay, Mergui Islands. Collected by Dr. Anderson.

* *Loc. cit.*

Fig. 3. *Petrosia testudinaria*, from the Straits of Malacca. Registered 83. 11. 8. 28 in the British Museum collection.

[All three figures are from photographs taken by Mr. Gepp from specimens in the British Museum, and they are all very much reduced.]

PLATE IV.

- Fig. 4. Spicules of *Rhaphidophlus spiculosus* (drawn under Zeiss E, Ocular 2, Camera). *a, b, c*, large tylostylote; *d, e*, small spined tylostylote.
- Fig. 5. Spicules of *Hymeniacidon? fatida* (drawn under Zeiss C, Ocular 2, Camera). *a*, small stylote; *b*, large oxete.
- Fig. 6. Spicules of *Acanthella Carteri* (drawn under Zeiss C, Ocular 2, Camera). *a*, oxete; *b, c, e*, stylote; *d*, strongylote.
- Fig. 7. Spicules of *Gelliodes carnosus* (drawn under Zeiss E, Ocular 2, Camera). *a, b*, oxete; *c*, sigmata.
- Fig. 8. Spicules of *Clathria corallitincta* (drawn under Zeiss E, Ocular 2, Camera). *a, b, c*, stylote; *d*, spined tylostylote.
- Fig. 9. Spicules of *Reniera madrepora* (drawn under Zeiss C, Ocular 2, Camera). *a, b, c*, oxete; *d*, stylote (abnormal).
- Fig. 10. Spicules of *Clathria indica* (drawn under Zeiss E, Ocular 2, Camera). *a, b*, tylostylote, verging upon unequal-ended oxete; *c*, spined stylote.

PLATE V.

- Fig. 11. *Acinella tubulata*, section taken at right angles to the surface, showing tubes of the commensal Annelid. *a*, tube with worm in it; *b, c*, empty tubes.
- Fig. 12. Spicules of *Acinella labyrinthica* (drawn under Zeiss C, Ocular 2, Camera). *a*, strongylote; *b, c*, stylote.
- Fig. 13. Spicules of *Auletta aurantiaca* (drawn under Zeiss C, Ocular 2, Camera). *a, b, d*, stylote; *c, e*, oxete.

X.—On a new British Species of *Microciona*, Bk., in which the ends of the Tricurvate are Spiniferous &c. By H. J. CARTER, F.R.S. &c., and R. HOPE, F.Z.S.

[Plate VI.]

§ 1. By MR. CARTER.

THIS species was conjecturally referred by me to *Microciona armata*, Bk. ('Annals,' 1874, vol. xiv. pp. 456, 457), on the supposition that the spiniferous character of the ends of the tricurvate spicules had been overlooked by Bowerbank. I now find I was mistaken, on which account it has probably hitherto failed to be considered a distinct species, and therefore has been

unrecognized by those who have written on the *Spongida* since that time, as lately proved by a specimen brought to my notice by Mr. Robert Hope, F.Z.S., of Cumberland Terrace, London, and which he found at Hastings. So convinced am I now by his preparations and arguments of the desirability of giving this British form of *Microciona* possessing a tricurvate with spiniferous extremities a distinct name and description, that I have much pleasure in joining him in thus publicly correcting the misconception and supplying the deficiency above mentioned.

It is not pretended that the presence of a tricurvate with spined extremities in *Microciona* is a peculiarity, for the form was described and delineated by the late Oscar Schmidt in 1870 as forming part of the spiculation of a species of *Suberites*, which he therefore called *Suberites arciger*. The specimen was very small, not being more than 4 centimetres in diameter, and came from the coast of Greenland ('Grundzüge atlant. Spong.-Faun.' p. 47, Taf. v. fig. 6).

The next delineation and description of this form of tricurvate was published by myself in 1876 as a part of the spiculation of a species of *Dictyocylindrus*, Bk., which I called *D. abyssorum*. The specimen, which was dendriform and branched, came from the Atlantic Ocean between the north of Scotland and the Faröe Islands, and was about $3\frac{1}{2}$ inches high ("Deep-sea Sponges and their Spicules, dredged by H.M.S. 'Porcupine,'" 'Annals,' 1876, vol. xviii. p. 232, pls. xii. and xv. figs. 3 and 25 respectively).

In 1874 also Dr. Bowerbank illustrated and described a species of *Isodictya* under the name of *I. coriacea* (Mon. Brit. Spong. vol. iii. pl. lxxvi. figs. 7-12, p. 228), in which this form of tricurvate was present; but he failed to notice the spined extremities, as may be seen by Mr. Stuart Ridley's emended description of the *same specimen* (now in the British Museum) under the name of *Dirrhopalum coriaceum* (Journ. Linn. Soc., Zoology, vol. xv. p. 481, pl. xxix. figs. 3-7), an example of which I also found here (Budleigh-Salterton, S. Devon) several years ago, even before Dr. Bowerbank's description (*l. c.*) was published, growing on the surface of *Stelletta aspera* in a cake-like form about an inch in diameter and half an inch thick in the centre, as the specimen which I still possess shows. To this sponge now Messrs. Ridley and Dendy have very properly given Schmidt's generic name *Plocamia* ('Challenger' Report, 1887, p. 158, pl. xxix. fig. 9 and pl. xxxi. fig. 1).

In 1874 I described the specimen of *Microciona* possessing the tricurvate with spined extremities to which I have alluded

at the commencement of this paper ('Annals,' vol. xiv. p. 456 &c.; for an illustration of the spined extremity &c. see *ib.* pl. xxi. fig. 27, *d*).

And in 1880-81 Vosmaer instituted a new genus, under the name of *Artemisina*, for a sponge that was brought from the seas about Spitzbergen by the 'Willem Barents' 2nd Expedition, which he named *A. suberitoïdes* (Bronn's Klass. u. Ordn. "Porifera," p. 351, Taf. xxvii. fig. 10), and which possessed a tricurvate with spined extremities. Also another under the generic name of *Amphilectus*, in the Leyden Museum, which, possessing the tricurvate, but *not* with spined extremities, he identified with *Microciona armata*, Bk. = *Scopalina toxotes*, O. S. (*ib.* p. 353, Taf. xvi. fig. 41). Thus *Amphilectus*, Vosmaer, is identified with Bowerbank's *Microciona*.

Finally, in 1887 Messrs. S. Ridley and Dendy's Report on the Monaxonida dredged by H.M.S. 'Challenger' was published, and in this three sponges have been described, viz. *Amphilectus apollinis*, *Rhaphidophylus lobatus*, var. *horrida*, and *Plocamia coriacea*, var. *elegans*, each of which possesses a tricurvate (*toxite*, R. & D.) with spined extremities, as illustrated in their plate xix. fig. 3 *b* and pl. xxix. fig. 4 *b*, respectively, for the first two, the last having only been described in the text (*op. cit.* p. 158). The only difference of any consequence between *Isodictya coriacea*, Bk. (1874), and the var. *elegans* of Ridley and Dendy appears to me to be in the adult form, that is in the manner of growth, Bowerbank's specimen and my own being massive, while the 'Challenger' variety is dendriform and branched (pl. xxxi. fig. 1).

Thus the tricurvate with spined extremities *alone* in *Microciona* is of no specific value; but when combined with other characters will be found to constitute a distinct species, as will be seen from the following description by Mr. Hope.

§ 2. By MR. HOPE.

Microciona spinarcus, n. sp. Crtr. (Pl. VI. figs. 1-6.)

The sponge alluded to by Mr. Carter in the preceding remarks on the prevalence of the tricurvate (*toxite*, R. & D.) with spined extremities was obtained by me in the month of February of the present year (1888) on the "Stade" at Hastings among the heaps of scallops piled up there as they are landed from the fishing-boats of the town.

It coats very nearly the whole fragment, about 25 millim.

long and of breadth varying from about 10 to 20 millim., of a dead shell of a small species of *Pecten* (?), itself with other objects entangled in threads of byssus, and thereby attached to a scallop. The sponge was dry when first observed and for the most part incrustated with an even layer of very fine dirt. The presence of some foraminiferal shells on the surface of this layer seems to point, though somewhat doubtfully, to its having been deposited in the sea; but I do not think it has any organic connexion with the sponge on which it lies, interfering very materially with the examination thereof. It is, indeed, somewhat uncertain if the sponge extends under the whole of the crust; but wherever this latter has been microscopically examined spicules have been found.

In places where this crust is absent, the sponge presents the appearance of an exceedingly thin colourless film, closely adhering to the ridges and furrows of the shell or connecting by a smooth erect veil the projecting teeth or processes with which the shell is furnished. Under the dirt-crust the film probably lies evenly on the ridges, bridging over the furrows, as it also does in places at the edge of the crust. The basal film, where it is exposed, bristles with upright, generally solitary spicules; probably in this place the sponge was extending its borders, for wherever the dermal membrane is well developed it appears as a glistening mat of spicules, only slightly hispid through the occasional penetration of single upright spicules from beneath.

On examination of a preparation under a power of about 50 diameters, the main skeleton is seen to consist of upright "scopuliform bundles" of spicules (Pl. VI. fig. A, 1), as in Mr. Carter's description, in this case somewhat sparsely distributed and of comparatively small dimensions, and replaced in parts by radiating tufts of spicules springing directly from the basal membrane. Probably these tufts may be immature columns, as pointed out by Dr. Bowerbank in the case of *Microciona atrosanguinea* (Mon. Brit. Spong. vol. ii. p. 149). In consequence of the slight development of the main compared with that of the dermal skeleton the dry aspect of the sponge is "flat and even," in marked contrast with the hispid papillæ of *M. atrosanguinea* and *M. armata*.

Measurements of the spicules, which differ considerably from those of the specimen described by Mr. Carter ('Annals,' 1874, vol. xiv. p. 457), but approach more closely to those of another specimen of which he has very kindly sent me a preparation* for comparison, are as follows, the diameter given being in all cases that of the largest spicules.

* This was found a few years ago growing over the surface of a red

Megasclera * three, viz.:—1. Long, slightly curved styles, sometimes very slightly constricted, sometimes slightly swollen above the base, and studded at the base with round tubercles or blunt spines about $\cdot 34$ to $\cdot 48$ millim. \times $\cdot 009$ millim. (fig. A, 2). 2. Entirely (but generally somewhat sparsely) spined, straight or slightly curved styles, gradually tapering, basally truncate to subtylote, varying much in size, about $\cdot 08$ to $\cdot 204$ millim. \times $\cdot 0075$ millim. (fig. A, 3). 3. Long, slender, smooth styles, slightly clavate, about $\cdot 22$ to $\cdot 308$ millim. \times $\cdot 0035$ millim. (fig. A, 4).

Microsclera two, viz.:—1. Very slender toxa, having the ends much produced and the tips sharply spined, very various in size, ranging from about $\cdot 048$ to $\cdot 29 \times \cdot 0025$ millim. (fig. A, 5). 2. Minute palmate isochelæ, palmæ subtriangular, comparatively rare, length $\cdot 008$ to $\cdot 012$ millim., average about $\cdot 0105$ millim. (fig. A, 6).

For comparison measurements are appended of the corresponding spicules of *Microciona armata*, taken from a specimen found coating red sandstone on the shore at Sidmouth, S. Devon. This sponge appears to be somewhat rare, and its occurrence on rock between tide-marks, if not previously noticed, is of some interest, the specimens mentioned by Dr. Bowerbank (Mon. Brit. Spong. vol. ii. pp. 130, 131) being on shells and apparently from deeper water.

Megasclera.—1. Stout, basally tuberculated or spined styles, mainly two sizes, with fewer intermediates, one size ranging from about $\cdot 23$ to $\cdot 35$ millim. in length, the other from about $\cdot 53$ to $\cdot 627$ millim. long; breadth in both cases about $\cdot 02$ millim. (fig. B, 2). 2. Spined styles of the very characteristic form described and figured by Dr. Bowerbank (Mon. Brit. Spong. vol. ii. pp. 129, 130, 131, and 141, and vol. iii. pl. xxiii. fig. 24), $\cdot 16$ to $\cdot 2 \times \cdot 016$ millim. at base (fig. B, 3); there are also some smaller ones only about $\cdot 008$ millim. in diameter. 3. Slender styles about $\cdot 312$ to $\cdot 428 \times \cdot 0065$ millim. (see "Note," Explanation of Pl. VI.).

Microsclera.—1. Toxa quite smooth at tips, $\cdot 022$ to $\cdot 19 \times$ about $\cdot 0025$ millim. (fig. B, 5). 2. Palmate isochelæ, abundant, generally $\cdot 013$ to $\cdot 017$ millim. in length, a very few observed $\cdot 0215$ to $\cdot 023$ millim. long (fig. B, 6).

It will be seen, from a comparison of the spicular measure-

clay-boulder about "low-water mark" in company with a variety of *Hymeniacidon Dujardini*, Bk., of a jet-black colour when fresh.—C.

* The names of the spicules are in accordance with Ridley and Dendy's nomenclature in their Report of the 'Challenger' Monaxonida, part lix. (1887).

ments of the two sponges, that :—1, while the main skeleton-spicula of the former are in length intermediate between the two chief divisions of those of *M. armata*, they are little more than one third as thick; 2, the characteristic spined styles of *M. armata* are entirely absent from the sponge under consideration, being replaced by spicules approaching more nearly to the corresponding form in *M. atrosanguinea*. Turning to the microsclera, we find, 1, that while none of the other spicules of our sponge attain to the dimensions of those of *M. armata*, the toxa exceed in length those of the latter sponge by fully one half, viz. .29 against .19 millim., the largest respectively; if the average be taken, the proportional difference will be found fully as great. They differ also in possessing in the one case *spined* and in the other perfectly *smooth* tips. 2. On the other hand the chelæ of this sponge are on the average only about two thirds as long as those of *M. armata* and much less numerous.

The possession of this specimen of *M. armata* enabled me to bring to the notice of Mr. Carter the differences between the two sponges, and these proved, as above stated, to be in his judgment of specific value. The points more especially relied upon in support of this view Mr. Carter leaves me to state. They are as follows:—1, the difference in the skeletal arrangement of the two forms, which is exceedingly striking on an inspection of balsam preparations, the “scopuliform bundles” of *M. spinarcus* (fig. A, 1) being weak and “unarmed,” while those of the aptly-named *M. armata* angrily bristle on all sides with their thorny styles, and recall vividly the trophies of swords and bayonets which decorate an armoury (fig. B, 1); 2, the complete absence in the former sponge of the characteristic spined style of the latter; and 3, the spination and great increase in size, both absolutely and particularly relatively, of the toxa in *M. spinarcus*. As regards the last point, the largest main skeletal spicules are to the largest toxa in length in *M. armata* as 3.3 to 1, in *M. spinarcus* only as 1.66 to 1. If the average of the spicules were taken, the discrepancy would be, I believe, quite as great; but where the spicules vary so very much in size, the average must be so much a matter of appreciation that it seems better to give measurements of the largest spicules, which are easily recognized.

From *M. atrosanguinea* our sponge differs chiefly in the shape and spination of the main skeletal spicules and in the form, size, and spination of the toxa. Slighter divergences in the other spicula will be best appreciated by inspection of the annexed Plate VI. figs. A and C, 2–6 inclusively. The

spiculation generally is finer than in either *M. armata* or *M. atrosanguinea*, and the even flat habit in the growth of the sponge is also a point of difference from both species. The spicules of *M. atrosanguinea* figured (viz. C, 2, 3, 5, and 6) are from a Hastings specimen taken at the locality given by Dr. Bowerbank (Mon. Brit. Spong. vol. ii. p. 140).

As the sponge (*M. spinarcus*) coats a shell, it has been possible by decalcifying the latter to get a very small portion fairly undisturbed and mounted for microscopical examination. In the part thus treated I have been able to detect only one form of spicule in the "scopuliform bundles" and radiating tufts of the main skeleton, viz. the large basally tuberculated styles (fig. A, 2). The long, slender, smooth styles (fig. A, 4) lie in wisps in both the basal and dermal membranes; the toxa (fig. A, 5) have been seen in the basal film only, where they seem to be roughly arranged in lines with the ends of the component spicules overlapping; their abundance, however, makes it probable that they are to be found in other parts of the sponge also. The spined styles stand upright from the base in the intervals of the bundles and tufts, sometimes echinating the wisps of spicules. No chelæ were detected *in situ* (fig. A, 6). The piece suitable for examination is, however, so comparatively minute and the dry condition of the sponge so unfavourable that these observations are probably of no value; they are given only for what they are worth.

The generic name "*Microciona*" has been provisionally retained for the purposes of this paper for what may perhaps be denominated the typical division or group of Dr. Bowerbank's genus of that name (comprising *M. armata*, *M. atrosanguinea*, and, if the above views be allowed, *M. spinarcus*), mainly on account of the close resemblance of the spiculation of the group to that of some species of the genera *Clathria* and *Rhaphidophlus*. This seems to be a strong argument in favour of the course pursued by Mr. Carter in placing *Microciona* in his family "Ectyonida," which is given by Messrs. Ridley and Dendy as a synonym of their subfamily "Ectyoninæ" ('Challenger' Reports, "Monaxonida," p. 128). This would imply the exclusion of the group from the genus *Amphilectus*, Vosmaer, which is a member of the subfamily "Esperellinæ," Ridley and Dendy (see 'Challenger' Monaxonida, p. 123). The occurrence of the spined toxa in *M. spinarcus* somewhat strengthens the case; in *Rhaphidophlus lobatus*, for instance, each of the five different forms of spicule possessed by that sponge is represented in the "*Microciona* group" by a closely similar form ('Challenger'

Monaxonida, p. 154, pl. xxix. figs. 4, 4 *a*, 4 *b*, and 4 *c*), and its echinating spicule is almost identical with that of *M. armata*. I do not know whether Messrs. Ridley and Dendy's dictum under this species, that "there can be little doubt that these spined spicules are really homologous with the echinating spicules of allied species" (*ib.* p. 154), can be fairly and without straining applied to this "*Microciona* group;" if it can it may perhaps be inferred that these gentlemen would have included the group in the Ectyoninae had the point arisen for their discussion. But the 'Challenger' had none of the species of it, and all the species of *Amphilectus* described by them in their Report are without spined styles.

The skeletal arrangement also of this division of *Microciona* appears to me to have considerably greater affinity with that of *Clathria* than with that of an Esperelline sponge.

I desire to express my great indebtedness to Mr. Carter for his most kind and courteous assistance and advice, including the loan of rare specimens and microscopic preparations from his own collection, also to tender my thanks to Dr. A. Günther, F.R.S., Keeper of Zoology at the Natural-History Museum, for kind advice and permission to make use of the National Collection freely accorded, as well as to Mr. R. Kirkpatrick, in temporary charge of the sponges in the Museum, for much trouble taken on my behalf.

It is proposed to deposit the specimen which has given occasion for these remarks, with microscopic preparations of the skeleton and spicules, in the Natural-History Museum.

EXPLANATION OF PLATE VI.

A. *Microciona spinarcus*.

B. *Microciona armata*.

C. *Microciona atrosanguinea*.

Fig. 1. A scopuliform bundle of the skeleton.

Fig. 2. Main-skeletal spicules.

Fig. 3. Entirely spined styles.

Fig. 4. Long slender style.

Fig. 5. Toxites.

Fig. 6. Isochelæ.

Fig. 1 magnified 50 diams.; figs. 2-5, 250 diams.; fig. 6, 850 diams.

Note.—Spicules of the form no. 4 in *M. armata* and *M. atrosanguinea* are not figured, as they differ but slightly from those of *M. spinarcus* except in size. Those of *M. armata* are sometimes spined at the base in the axial line.

XI.—*The Occurrence of Lichia vadigo on the British Coast.* By Dr. A. GÜNTHER, F.R.S.

THE fishes of the genus *Lichia* have a wide range in the Atlantic Ocean; they lead a more or less pelagic life, wandering in pursuit of the small Clupeoids, on which they feed. Hitherto only one species, *Lichia glauca*, has been met with in a few instances as a wanderer to the south coast of England; and it is therefore a matter of sufficient interest to place on record a well-authenticated case of the occurrence in British seas of *Lichia vadigo*, a much scarcer species, of which the British Museum has previously succeeded in obtaining one specimen only, due to the exertions of the late Rev. R. T. Lowe, who acquired it at Madeira.

The specimen is a well-preserved skin, 20 inches long, and was sent to me by Lieut.-Colonel W. Gostwyck-Gard, of Inverness, for identification. He writes that it was taken in a drift of herring-nets on September 17th, 1888, off Waternish Point, Isle of Skye. It is to be hoped that so valuable a specimen, on which the evidence as to the admission of this species into the British fauna depends, will be preserved in some public museum.

British Museum (Natural History),
December 30, 1888.

XII.—*Description of a supposed new Species of Helix from near Moulmain, Tenasserim.* By Lieut.-Col. H. H. GODWIN-AUSTEN, F.R.S., F.Z.S., &c.

THIS shell formed part of a collection made by Mr. Ossian Limborg during an expedition from Moulmain to the Moo-le-it range in the spring of 1877. His collection included some interesting species as they were sent up alive to Calcutta, and I was thus enabled to examine them in this state and afterwards more closely in spirit. The shell now described is included in Mr. Nevill's catalogue of the shells in the Indian Museum, Calcutta, and was presented to the museum by me under the title by which I now distinguish it, and I leave it in the genus in which Mr. Nevill placed it (p. 73 of his catalogue).

Helix (Ægista) mitanensis, n. sp.

Locality. Mitan, under Moo-le-it Range, Moulmain (*Ossian Limborg*).

Shell globosely pyramidal, openly umbilicated; sculpture smooth, the shell covered with a thick epidermis, having a finely papillate structure; colour dark olive-green or pale umber; spire conic, high, apex blunt; suture impressed; whorls 6, rather convex and rounded below, the last descending abruptly at the aperture; aperture circular; peristome strong, white, with a sinuate margin above; columellar margin oblique.

Size: maj. diam. 10·9, min. 9·4; alt. axis 6·7, body-whorl 5·2 millim.

Animal with dark tentacles, long and fine; body papillate near the head, pale, dusky on the upper surface; foot short behind and pointed. In some specimens the head and tentacles were jet-black, the rest of the body pale indigo.

XIII.—*The Staphylinidæ of Japan.*

By Dr. D. SHARP.

[Continued from p. 44.]

PHUCOBIUS.

This genus has, by an error of observation of M. Fauvel, been merged in *Cafius*. The ligula is, however, of a different type from that obtaining in *Philonthus* and *Cafius*, and the general structure brings the insect nearer to *Ocypus*; the ligula, though not large, is not at all acuminate at the apex, and its two lobes are evidently separated though not deeply divided. This statement is based on the observation of several examples at different times and of a preparation of the part mounted in Canada balsam. Dr. Horn is more correct in supposing that *Philonthus canescens*, Mann., may be a *Phucobius*; I find, however, although there is a considerable analogy between the two insects in many respects, yet they are far from agreeing in their structure. In the North-American insect the division between the lobes of the ligula is only indistinct, the palpi, mandibles, antennæ, and

legs are much thicker, the middle coxæ more widely distant, the neck much broader and less abrupt, and the details of structure so different that the two have a very different facies. Hence the North-American insect should form a distinct genus and *Phucobius* remains peculiar to Japan and China.

Since the above was written, Casey has published a note on this genus in Bull. Cal. Ac. Sci. i. p. 313, and proposed the genus *Bryonomus* for the North-American species above referred to.

Ocypus nigro-æneus, n. sp.

Elongatus, parallelus, angustulus, niger; capite thoraceque nigro-æneis, nitidis, haud pubescentibus; elytris abdomineque opacis; antennis extrorsum rufis.

Long. 20 millim.

Antennæ short, black at the base, red at the apex, the two or three penultimate joints transverse. Head nearly as broad as the thorax, very densely punctured except along the middle. Thorax about as long as broad, shining brassy black, numerous punctures of moderate size, and smaller ones intermixed; a well-marked space along the middle smooth; scutellum clothed with black pile. Elytra dull black, scarcely brassy, sculpture indistinct. Hind body not variegate.

This is closely allied to our European *O. fuscatus*, but is larger and has numerous points of distinction.

Subashiri, Nanai; Hakodate, Sept. 1880; eight examples. I have the species also from Olga Bay, on the coast of Korea.

Ocypus Weisei.

Ocypus Weisei, Harold, Deutsche ent. Zeitschr. 1877, p. 344.

This remarkable insect, though very rare, has been found in all the three islands of the group. Shiba at Tokio, Nara near Kiota and Nanai, Hakodate, are localities for it.

Ocypus dorsalis, n. sp.

Niger, opacus, pedibus flavis; abdominis segmentis duobus penultimis aureo-maculatis; antennis basi rufis, medio fuscis, apice albidis; elytris abbreviatis.

Long. 18 millim.

Antennæ rather slender, each joint narrowed at its base,

the penultimate joint scarcely so long as broad, the four terminal joints very pale yellow, almost white. Head broad, quite dull, finely and not densely punctate, and with a rather scanty, fine, dark fuscous pubescence. Thorax longer than broad, the sides slightly sinuate in front, the colour and sculpture like those of the head. Elytra not much more than half as long as the thorax, dull black. Hind body a little enlarged before the apex, dull black, with a very fine pubescence, not visibly sculptured, the penultimate segment and that preceding it each with a large spot of golden pubescence on the middle. Legs bright yellow. Terminal ventral plate of male with a broad, not very deep excision.

We have no species like this in Europe; perhaps *O. aethiops* is the least dissimilar, but, in addition to numerous other distinctions, *O. dorsalis* has a well-marked stigmatic membrane.

This elegant species was found at Niohozan in June, near where snow then remained, and also at Chiuzenji in August.

Ocypus scutiger, n. sp.

Niger, opacus; pedibus antennisque piceis, his extrorsum albidescentibus; abdomine dilatato, segmentis duobus penultimis aureomaculatis; elytris abbreviatis.
Long. 23 millim.

Although closely allied to *O. dorsalis*, this is no doubt distinct; it is considerably larger and has the hind body broader, the legs and base of the antennæ of darker colour, and the latter organs rather longer, the third joint especially being longer, and the penultimate joint being rather longer than broad.

Only two examples were obtained; Chiuzenji, 20th August, 1881.

Ocypus brevicornis.

Ocypus brevicornis, Weise, Deutsche ent. Zeitschr. 1877, p. 367.

This is found, but not commonly, under the bark of firs, to which habitat it appears to be confined; Miyanoshta, Yunoshiku, Subashiri, Nishi, Oyama.

AGELOSUS, nov. gen.

Ligula lata, longius biloba. Palpi parum elongati, sat robusti, labialium articulo ultimo leviter incrassato, apice truncato. Pro-

thorax lineis lateralibus haud conjunctis. Coxæ intermediae contiguæ; mesosternum inter eas minus breviter productum, simplex.

This genus, apart from the structure of the side-piece of the prothorax, might be looked on as a close ally of *Ocypus*; but as this part is developed somewhat as in the *Xanthopygini*, it is of considerable interest. The side-piece is large, much inflexed at the base, and both its limiting lines run forward as far as the front angles of the thorax, where, though much approximated, they are still quite separate and, the upper or outer one at any rate, distinct, then being turned upwards to the front face of the thorax, the lower or inner line at once disappears by being carried to the inside of the thorax. In this latter respect the genus differs from the *Xanthopygini*, where the inner line is continued upwards to form the front margin of the thorax, the outer line becoming obsolete at the prominent anterior angle. In the normal *Ocypus*-allies the two lines become so closely approximate that they may be called conjoined at the side of the prosternum.

Agelosus agrees with *Amichrotus* and *Anisolinus* in respect of this character, but it differs from both by numerous points of importance, such as the bilobed ligula, the structure of the palpi, and the mesosternum. The only species of the genus is *Goërius carinatus*, Sharp (Trans. Ent. Soc. Lond. 1874, p. 32).

This species was found in several localities, but only in few examples; these, however, exhibit much variation in the length of the elytra and in the colour of these parts and of the legs and antennæ. The elytra are sometimes nearly as long as the thorax, sometimes much shorter than it, and their colour, as well as that of the legs and femora, being apparently normally red, becomes to a greater or less extent black. There appears, however, only to be one species amongst these variations. The male has a broad shallow excision of the hind margin of the last ventral plate, the front being broadly dilated in each sex.

Kashiwagi, Nikko, Ichiuchi, Miyanoshita, Buno, Iga, Hakone, Sapporo; in one or two examples from each locality.

MIODELUS, nov. gen.

Ligula emarginata, palpi breviusculi sat robusti, mandibulae breves. Tarsi anteriores sat dilatati; metasternum elytraque brevia; pedes graciles.

This is a curious genus, established for an insect having

somewhat the appearance of *Ocypus dorsalis* and *O. scutiger*, but very different in many respects. The antennæ are rather slender, of the *Ocypus* type. The palpi are rather short, and there is no incrassation of the terminal joint either on the maxillary or labial palpi; the second joint of the maxillary is not dilated, and the middle joint of the labial is not longer than the basal and not so long as the apical joint. The thorax is of much more slender form than it is in *Ocypus*, and is quite differently formed, the sides being deflexed and the side-piece small, not much infolded, and its lower marginal line joining the upper at some little distance behind the coxal articulation, and thus being remote from the lateral tactile setæ. The middle coxæ are contiguous and their apex extends just about to the base of the posterior coxæ. The legs are slender, the basal joint of the hind tarsus much longer than the apical.

These characters bring the genus nearer to *Philetærius* (p. 118) than to any other, and yet the two are very different in appearance; and it appears that whereas the genus just named connects the Eucibdelini with the *Philonthus* group of genera, *Miobdelus* connects the Eucibdelini with *Ocypus*.

Miobdelus brevipennis, n. sp.

Niger; capite thoraceque subænescentibus, densissime punctatis; antennis articulo ultimo pedibusque extrorsum rufescentibus; elytris thorace multo brevioribus, plaga humerali parum conspicua rufescente, hic inde pubescentia submaculatis; abdomine subdilato, ultra medium macula magna aurata.

Long. 15 millim.

Antennæ slender, each joint narrowed to the base and each longer than broad, the tenth quite distinctly so, the terminal joint red and some of the preceding joints red at the base. Head circular, extremely densely rugose-punctate. Thorax rather slender, transversely very convex, a good deal narrowed behind, very densely rugose-punctate, only an excessively narrow carina along the middle shining. Elytra short, narrow at the shoulders. Hind body black, dull, only obsoletely variegated except for a very large mark of golden pubescence on the antepenultimate segment. Legs slender, femora nearly black, tarsi red, tibiæ intermediate in colour.

The male has not been obtained.

Niohozan, June, Nikko, August; an example from each locality.

ANISOLINUS, nov. gen.

Mandibulæ elongatæ, graciles; palpi tenues, maxillarium articulo secundo valde dilatato, labialium articulo secundo quam basali multo longiore. Prothorax lateribus haud deflexis. Coxæ intermediae contiguæ. Mesosternum carinatum.

This is another genus of whose exact affinities it is at present impossible to feel very sure; but it appears to connect *Amichrotus* with the *Ocypodes*. It agrees to a considerable extent with *Amichrotus* in the structure of the trophi, the ligula being entire, or, rather, its two lobes small and so compressed together that scarcely any division can be seen between them at the prominent extremity, and the two genera also have in common the unusually great dilatation of the second joint of the maxillary palpi; also in both the lateral lines of the prothorax are not joined. But in the present genus the sides of the prothorax are not deflexed and the superior lateral line thus remains closely approximated to the tactile setæ, the prothoracic structure differing thus apparently but little from that of *Agelosus*. The hind tarsi are elongate, with the basal joint longer than the apical. The two species of the genus are very different from one another in appearance.

It will perhaps be necessary to make a special group for these three genera, to which probably the Central-American *Misanthius* may be found to belong.

Anisolinus picticornis, n. sp.

Elongatus, angustulus, niger; antennis variegatis, articulo ultimo et articulis 4^o-7^m nigricantibus, articulis 8^o-10^m albidis, basi, palpis, pedibus elytrorumque macula humerali rufis; prothorace elongato, nitido, minus crebre punctato; elytris hoc brevioribus.

Long. 16 millim.

Antennæ slender, not at all thickened externally, penultimate joints each much longer than broad. Head circular, very densely punctured at the sides and behind, but with a large irregular space along the middle smooth. Thorax much longer than broad, nearly straight at the sides, though a little narrowed at the deflexed and indistinct anterior angles; the surface is shining, without clothing, sprinkled with rather fine elongate punctures, but with a narrow space along the middle impunctate. The elytra are shorter than the thorax and are dull, without distinct sculpture, and probably bear a black tomentum, under which they are of a somewhat bluish

tinge. The hind body is elongate and *Philonthus*-like, with a somewhat close punctuation and apparently depressed pubescence.

A single female example was found at Miyanoshita in May 1880; it is unfortunately in a decayed condition, so that it will not bear proper cleansing.

Anisolinus elegans, n. sp.

Elongatus, angustulus, opacus, niger: antennarum articulis ultimis quatuor albidis, pedibus, palpis elytrorumque fascia lata basali rufis, femoribus fuscis; abdominis segmento ultimo fascia basali flava; densissime punctatus.

Long. 12 millim.

Antennæ slender, each joint much longer than broad. Head circular, very densely and somewhat coarsely punctate, with only a small spot on the middle smooth. Thorax elongate, nearly straight-sided, but the sides a little narrowed in a curve to the flexed and obscure front angles, the surface extremely densely subrugosely punctate, the interstices being indistinct. Elytra about as long as the thorax, with a large red basal band less extended at the suture; very densely, finely, and indistinctly punctate, with extremely fine depressed pubescence. Hind body dull, obsoletely punctured, except at the base of each segment, where the punctuation is definite. The male front tarsi are moderately dilated and the apical ventral plate has a slight apical emargination preceded by a depressed smooth space.

A single example was met with at Miyanoshita in May 1880.

AMICHROTUS, nov. gen.

Mandibulæ elongatæ, graciles; palpi tenues; labiales elongati, articulo secundo quam ultimo vix longiore; ligula parva, integra. Prothorax angulis anterioribus rotundatis. Coxæ intermediæ contiguæ. Mesosternum ante eas longitudinaliter carinatum.

This very distinct genus is allied to the Central-American genus *Misantlius*, but is readily distinguished by the different proportions of the joints of the labial palpi, the middle joint being only about twice as long as the basal and scarcely longer than the terminal joint. The second joint of the maxillary palpi is thickened to a much greater extent than usual; the terminal portion of the mandible remarkably long, slender, and acute. The side-piece of the prothorax is peculiar in its

structure ; it is of large size, not much infolded, and its lower marginal line does not join the upper line, but is continued forward till near the front of the prosternum—quite as far as the front of the coxal excision—where it ceases ; the long tactile seta is remote from the upper line. The front tarsi are dilated in both sexes, strongly in the male, slightly in the female ; the hind feet are very slender and elongate and the basal and apical joints subequal in length.

Amichrotus apicipennis, n. sp.

Subdepressus, niger ; antennarum articulis ultimis albidis ; elytris ad apicem flavo-marginatis ; abdominis apice rufo, tarsis rufescentibus ; capite, thorace elytrisq̃ue dense punctatis, opacis, abdomine parcius punctato, sat nitido.
Long. 12 millim.

Antennæ rather slender, black, with the three or four terminal joints white. Head suborbiculate, very densely punctate. Thorax punctate like the head, with a very narrow, indistinct, smooth line along the middle. Elytra closely and rather finely punctate, the hind margin very pale yellow, and this part clothed with concolorous pubescence. Hind body rather shining, somewhat sparingly punctate, the three basal segments each with a broad, very deep, arcuate impression near the base ; the two terminal segments red. Tibiæ very slender, with only a few distant inconspicuous spinules. The male has a slight broad emargination of the apical ventral plate, and the penultimate segment is furnished in the middle with a patch of dense, elongate, depressed golden pubescence.

This remarkable insect frequents fungi on old standing timber, where it is met with walking about in a threatening attitude, and is associated with an earwig (*Chelisoches Lewisi*, Bormans) which behaves in the same way. It was met with sparingly at various dates and in several localities, from Miyanoshita to Junsai.

HADROPINUS, nov. gen.

Corpus crassum, apterum ; elytris metasternoque brevissimis, illis sutura integra ; tibiis anterioribus dilatatis.

This insect is to be placed with *Thinopinus* and *Hadrotes*, between which it is intermediate, and, as in them, the lateral lines of the thorax are not joined till the anterior angles are reached. The ligula is rather broad, but its lobes are not divided in the middle. The front tarsi are very broad

in each sex, and the front tibiæ are much dilated and are flattened, so as to present an edge externally; the mesosternum is divided by a curved line, which is armed with numerous long erect setæ; the middle coxæ are distinctly but not widely separated, and the metasternum is so short that they are separated only by a very small space from the hind coxæ. The legs are elongate, the basal joint of the hind feet long, equal to the following three joints together and longer than the terminal joint.

The genus differs from *Thinopinus* by the suture of the wing-cases being straight and from *Hadrotres* by the more slender limbs and palpi; also by the different form of the front tibiæ, which in *Hadrotres* are not flattened and are muricate on their posterior aspect.

Hadropinus fossor, n. sp.

Niger; abdomine piceo, elytris externe sordide testaceis; antennis pedibusque testaceis; elytris thorace brevioribus, prope suturam nudis, versus latera pubescentibus.

Long. 23 millim.

Head broad and short, narrowed in front, neck abrupt but thick, impunctate, eyes placed largely on the upper surface. Thorax impunctate, transversely convex, narrowed behind, not so long as broad. Elytra dark sordid yellow externally, near the suture dark, this latter part impunctate and bare, the paler part obscurely punctate and bearing a pallid, depressed, coarse pubescence. Hind body thick, dull, rather coarsely punctate, and with a short, scanty, flavescent pubescence.

Hakodate, three examples. This insect makes burrows in the sand under the seaweed, like *Brosicus* and *Scarites*.

LIUSUS, nov. gen.

Ligula integra, haud lata; prothorax lineis marginalibus usque ad angulos anteriores productis, linea superiore antèrius obsoleta. Metasternum elongatum.

This insect, though allied in respect of its structural characters to *Hadrotres*, next which it should be placed, must be treated as a distinct genus; besides differing by the elongate metasternum, it departs too much in the details of its structure to be associated with the North-American *Hadrotres*. The superior lateral line of the thorax, though quite obsolete in front, is readily traced, and leaves a broad side-piece, the width of which even at the front angles is considerable. The

palpi are less thick than in *Hadrotus*. The front tibiæ are moderately stout and are spinose behind. The mesosternum is not in the middle divided by any carina, but its smooth surface is crossed by some rather short stiff setæ placed in rather large punctures. The only species we have to deal with at present is

Liusus Hilleri.

Hadrotus Hilleri, Weise, Deutsche ent. Zeitschr. 1877, p. 93.

Found by Mr. Lewis at Hakodate. I have the species also from the coast of the Manchurian mainland.

Staphylinus chalcescens, n. sp.

Niger; capite, thorace elytrisque æneis, his cumque abdomine tomento flavescente subvariegatis; capite thoraceque subnitidis, sat fortiter punctatis.

Long. 20 millim.

Antennæ black, the penultimate joints strongly transverse. Head subtriangular, closely and moderately strongly punctured. Thorax subquadrate, with the base rounded, closely and rather coarsely punctured, with a dark fuscous pubescence; a small shining space in front of the scutellum; this latter clothed with black pile. Elytra of a dark brassy colour, not shining, very indistinctly variegated by a fine yellowish indistinct tomentum. Hind body black, with a faint flavescient triangular mark on the middle of each segment and at the side of each segment with an oblong mark of a similar faint kind. Legs black, anterior tarsi pitchy. Male with a very slight emargination of the hind margin of the last ventral plate.

This has a shorter thorax than *S. subæneus*, and the head and thorax are less densely punctate and bear dark pubescence; the antennæ and legs black, and the male characters different.

Nikko, 12th August, 1881; two examples.

Staphylinus vicarius, n. sp.

Niger; antennis extrorsum elytrisque rufis, tibiis testaceis, tarsis piceis, abdominis segmentis duobus ultimis ad basin albido-tomentosis.

Long. 17 millim.

This is of the size and form of *S. stercorarius*, but is not

closely allied to that species or to any other known to me. The three or four basal joints of the antennæ are blackish, the others red, the penultimate joints strongly transverse. The head and thorax are deep black, dull, closely and somewhat coarsely punctate, and bear a black pubescence; a narrow, indistinct, and short smooth line in front of the scutellum. Elytra dark red, about as long as the thorax. Hind body intense black, with a broad pale ashy ring on the base of the terminal segment, a narrower ring on that preceding it, and on the antepenultimate with a few pale hairs extending across the base. Femora blackish, tibiæ yellow marked with fuscous internally. The male has a slight excision of the last ventral plate.

Nikko, 16th August, 1881, two examples; Awomori, one example.

Staphylinus daimio, n. sp.

Niger: elytris, pedibus antennisque rufis, his medio nigricantibus, capite anterieus, collo, scutello, abdominis segmentis basali et tribus ultimis utrinque flavo-pubescentibus.

Long. 23 millim.

This is very closely allied to the European *S. erythropterus*, but differs as follows:—The stature is considerably larger, the antennæ are larger, with notably longer third joint, the thorax is broader, and the basal abdominal segment is spotted with yellow on each side. Thus, close as this species is to the European *S. caesareus* and *erythropterus*, it differs decidedly from either. The three individuals found are females.

Junsai and Sapporo.

PHILETÆRIUS, nov. gen.

Ligula biloba; palpi subrobusti; mandibulæ breves; prothorace transversim valde convexo, lateribus deflexis; coxæ intermediæ parum distantes; mesosternum haud transversim carinatum. Pedes graciles, tibiis pubescentibus haud spinulosis, anterioribus subincrassatis, haud deplanatis; tarsi anteriores in utroque sexu dilatati.

This is an interesting genus, intermediate between the *Philonthus* and the *Eucibdelus* groups of genera, and to be placed at the commencement of this latter group. The two lobes of the ligula are much compressed, so that the division between them is not very conspicuous, and in the structure of

this part it is intermediate between *Philonthus* and *Eucibdelus*. The maxillary palpi are stouter than those of *Philonthus*, but the proportions of their joints are similar, and, like all the other parts of the trophi, they are rather short; the second joint of the labial palpi is scarcely longer than the basal joint and shorter than the terminal joint. The labrum is divided to the base and its two lobes are larger than in *Philonthus*, though similarly formed. The head is short and has a neck about half its width. The thorax has the sides extremely deflexed, the marginal line not visible from above; it has no tubercular prominences near the front angles and its side-pieces are not inflexed. The legs are rather slender, the tibial spurs elongate, the claws small, the front feet in the female, as well as in the male, moderately dilated. The metasternum short.

Philetærius elegans, n. sp.

Niger: clytris abdomineque opacis, pube griseo-submaculata vestitis; capite thoraceque nitidulis, parce obsoleteque punctatis, parceque pubescentibus; antennis pedibusque sordide rufis, his femoribus, illis articulo basali fuscis.

Long. 13 millim.

Antennæ rather short, not stout, simple, not at all serrate, penultimate joint not quite so long as broad. Head rather short and broad, with rounded hind angles; eyes rather large, extending rather more than half the length of the sides; it has some faint blue or green reflexions, and the fine distant punctures are evenly distributed over its surface, a fine hair rising from each. Thorax slender, narrowed behind. Elytra short, not longer than the thorax, indistinctly densely punctate, tomentose, of a blackish or fuscous colour, with indistinct spots of a grisescent or a very pallid yellow colour. Hind body tomentose like the elytra, but the pallid pubescence scanty and not forming definite spots.

This species was found in the nests of a black ant (having the habits of *Formica fuliginosa*) at Bukenji on the 1st and 13th of April, 1884, four examples being captured. The sexual differences are small, consisting only of a feeble emargination of the last ventral plate in the male.

PHYTOLINUS, nov. gen.

Caput subquadratum; labrum permagnum, fissum; antennæ ad apicem subserratæ; palpi subrobusti, ligula fissa. Tibiæ ante-

riores dilatatae, teretes, tarsi anteriores latissime dilatati, laxi, articulo ultimo brevi, haud exserto.

This is another form of that interesting group of Staphylinini * of which *Eucibdelus* may be taken as the type, from all of which it is distinguished by the peculiar structure of the tarsi. Those of the front feet are very broad and somewhat asymmetrical, the outside lobe being differently shaped from the inner; the basal joint very short and very strongly transverse, the fourth joint large and dilated, the fifth short and broad, only its claws extending beyond the fourth joint, these abruptly curved to underneath the foot; on the middle and hinder legs the fourth joint is provided with slender elongate lobes, the claws of the elongate terminal joint large. The head is rather short and broad, as in *Trichocosmetes* and *Phileterius*, the thorax is without tubercular anterior prominences; both these parts are destitute of tomentum. The other characters appear to be much the same as in *Eucibdelus*.

* The following characters are those of the most remarkable genus of this group yet brought to our knowledge:—

RHYNCHOCEILUS, nov. gen.

Corpus elongatum, gracile, tomentosum. Labrum omnium maximum, capite paulo brevius, anteriùs acuminatum et deflexum, usque ad basin fissum, lobi singuli marginibus hirsutis. Palpi maxillares subrobusti, articulo ultimo quam precedente brevior; palpi labiales crassi, articulo secundo apicem versus incrassato, articulo ultimo parvo crasso. Caput elongatum, oculis convexis. Prothorax absque prominentia, angulis anterioribus rotundatis, omnium maxime deflexis. Tibiæ pubescentes, espinulosæ, anteriores dilatatae, teretes; tarsi anteriores in utroque sexu dilatati.

Rhynchoceilus pectoralis, n. sp.

Niger; antennarum basi pedibusque testaceis; elytris fulvis; capite thoraceque dense subtiliter punctatis, flavo-tomentosis, illo anteriùs bi-impresso; elytris elongatis, dense subtiliusque subrugose punctatis, tomento sparsò irregulariter, quasi maculatis, vestitis; abdomine elongato, angusto, tomento pallide flavo vestito, segmentis basalibus singulis in medio ad apicem convexo, ibidemque nudo, nitido.

Long. 23 millim.

Mas segmento ultimo ventrali ad apicem profunde exciso.

Hab. Malacca, Castelnau.

The enormous labrum is interesting when we bear in mind the similar increase in this organ in some of the wonderful Cicindelidæ found in the same region. Like them this insect is no doubt arboreal and predaceous in its habits; the slender hind tarsi are densely pubescent beneath and their angles sufficiently prolonged to be called sublobate. Wallace found a second smaller species in Malacca, I believe at Mount Ophir.

This genus is an example in the Staphylinidæ of the reproduction of some of the characters of species with tarsi like *Phytophaga*, and we may assume that its habits are arboreal.

Phytolinus Lewisii, n. sp.

Niger; antennis pedibusque flavis, illis articulis ultimis nigricantibus; elytris elongatis, disco late flavescente; abdomine nitido, transversim albedo-sericante.

Long. 17 millim.

Head black, finely punctate, the punctuation in front very dense, on the vertex more sparing and coarser, and therefore this part is shining. Thorax slender, not elongate, extremely convex transversely, shining black, closely and rather finely punctate, the surface rather uneven, and with a very indistinct, narrow, smooth line along the middle. Scutellum large, densely and extremely finely punctate. Elytra black at the base and hind angles, with a large tawny band dilated near the suture across the middle, the inflexed sides also tawny, the median band variegated with rather scanty white and flavescent pubescence. Hind body rather slender, shining black, scarcely punctate, variegated with scanty shining white pubescence placed transversely. Legs clear pale yellow, the coxæ fuscous, and the base of the front femora of the same colour.

I am not able to point out any sexual characters; in one of the specimens there are two, in the other two specimens three, joints of the antennæ dark, and there is also an apparently variable transverse impression on the middle of the head between the eyes.

Kashiwagi, June; Nikko, August. Beaten off foliage.

[To be continued.]

XIV.—*Descriptions of twenty-four new Species of Butterflies captured by Mr. Last in the neighbourhood of Mombasa, East Coast of Africa, in the Collection of Mr. H. Grose Smith.* By H. GROSE SMITH.

Papilio polistratus.

Male.—*Upperside.* Both wings dark brown with green spots and markings. Anterior wings with spots as in *poli-cenes*, Cram., but the markings across the cell more linear

and undulated. Posterior wings with a green stripe following the inner margin from the base halfway down the wings, a nearly central band of three longitudinal spots divided by the nervures, the spot on the costal margin nearly white, the other two green, the lowest spot shorter than in *policenes*; between this band and the submarginal row of linear spots are two spots, one on the costal margin oval, nearly white, the other below the first subcostal nervule smaller, oval, acuminate at the lower end; a submarginal row of spots.

Underside with markings as above, but anterior wings paler; posterior wings blacker, the latter with a central linear red band in the middle of a broad dark band, and red markings curving between the median nervules to the inner margin a little above the anal angle; a broad dark band crosses the disk beyond the centre.

Expanse of wings $2\frac{7}{8}$ inches.

This butterfly is between *policenes* and *porthaon*, Hew.; it is probably a hybrid between these species or between *policenes* and *colonna*, Ward.

Belenois liliana.

Male.—Upperside. Very faintly greenish white, with black veins. Anterior wings with apex and apical third of the costa rather broadly blackish grey, the rest of the costal region, the upper and basal portion of the cell, and the base of the wing below it densely irrorated with dark grey, the discoidal and two upper median nervules tipped with black. Posterior wings: the base grey, the median nervules and submedian nervure minutely tipped with black.

Underside.—Both wings white, greyish at the base. Anterior wings: the costal region broadly grey, thence along the costal margin and at the apex grey, tips of the veins down to the lowest median nervule minutely black; a large greyish-black spot in the middle between the uppermost and second median nervule, two minute grey spots on each side of the upper discoidal nervule towards the apex, a minute black spot at the end of the cell. Posterior wings with an irregular row of indistinctly marked grey spots across the disk, and following the curve of the wings towards the inner margin; a small grey spot near the base above the subcostal nervure, another at the end of the cell; all the veins tipped with greyish black.

Female.—Upperside. Both wings yellowish white, densely irrorated with grey in the basal area. Anterior wings with apex and outer margins broadly greyish black, which, along

the inner side of the outer margin, follows the veins to a row of greyish-black patches or spots which cross the disk beyond the middle, the uppermost spot being confluent with the greyish black of the apex and outer end of the costa; the next spot smaller and indistinct, the next large and round and contiguous with the spots above and below it; the latter is small and extends over only the upper part of the space between the second and lowest median nervule; the fifth larger, between the latter nervule and the submedian nervule; the sixth on the inner margin indistinct and elongated; a small spot at end of the cell. Posterior wings: veins broadly tipped on the outer margin with triangular, greyish-black, ill-defined spots; an indistinct curved row of greyish spots, more or less confluent, beyond the middle of the disk; a minute spot at end of the cell.

Underside. Anterior wings greyish white, showing the markings on the upperside, but less distinctly except the large third spot of the discal row. Posterior wings stramineous, with the discal row of spots as on upperside, and a very distinct spot at end of the cell; veins minutely tipped with black on the outer margin.

Expanse of wings 2 inches.

Near to *charina*, Hew., and *simana*, Hopfl., but is larger, with wings comparatively shorter and rounder; the colouring of the male is different and the veins are all black. The female differs widely from the female of either of those species. The undersides of both sexes are also different.

Belenois isokani.

Male.—Upperside. Both wings pure white, slightly grey at the base. Anterior wings with a grey band with white streaks from the apical fourth of the costa along the outer margin, widest on the costa, gradually narrowing to the inner angle; the inner edge of the band curved and the lower part rather deeply dentate.

Underside. Anterior wings white, pale yellow at the base. Posterior wings tinged with very pale yellow, deepest at the base of the costa.

Female.—Upperside. Anterior wings creamy white, brightly tinged with orange at the base; the grey band as in the male, but lighter, the veins across it darker grey; costal margin rather broadly grey. Posterior wings yellowish white, yellower towards the base; rather large grey tips to the veins on the margin.

Underside. Both wings creamy white. Anterior wings

with the grey patch of upperside only represented by a few minute spots on the outer margin; the apex slightly stramineous; base and inner two thirds of cell bright orange. Posterior wings: costa towards the base orange, veins minutely tipped with grey.

Expanse, ♂ 2, ♀ $2\frac{1}{8}$ inches.

Near *coniata*, Butl.

Mylothris Lasti.

Male.—*Upperside.* Anterior wings white, broadly tipped with greyish black, the black extending down the outer margin, gradually decreasing to the end of the second median nervule; the lowest median nervule and submedian nervule tipped with black, the latter minutely. Posterior wings lemon-yellow, the veins tipped with black spots, those on the second subcostal nervule and the discoidal nervule the smallest.

Underside.—Anterior wings white, with yellow apex. Posterior wings yellow, costal margin slightly orange; tips of the veins on outer margins of both wings black.

Female.—*Upperside.* Anterior wings white, apical third black, the black broadest on the costa, gradually decreasing in a curve on the inner edge to the inner angle; a few grey streaks in the black; base and basal part of the costa grey. Posterior wings lemon-yellow, with large black spots at the tips of the veins, that at the anal angle the smallest.

Underside. Both wings as in the male, the spots at the tips of the veins in the posterior wings smaller than on the upperside.

Expanse of wings 2 inches.

Near to *trimenia*, Butl., but the wings are shorter and broader, the apical black patch in both sexes is much broader, and the marginal spots on the posterior wings of the female are much larger. In another form of the female the posterior wings on the upperside are creamy white and on the underside buff.

Mylothris nagare.

Male.—*Upperside.* Both wings white. Anterior wings with apex and outer margin broadly black, broadest on the costa, and gradually decreasing towards the inner angle, the lower half dentated on the inner edge; costa and base grey. Posterior wings with veins minutely tipped with grey.

Underside. Anterior wings white, base and apex stra-

minous; two grey spots on the two lowest median nervules near the margin. Posterior wings pale creamy white; base of costa pale yellow.

Female.—*Upperside*. Anterior wings creamy white, apical third more broadly black than in the male, with two grey streaks near the apex, the inner edge on the lower part deeply dentate; base and basal two thirds of costa dark grey. Posterior wings brighter creamy white; a marginal row of grey spots at the tips of the veins, densely irrorated between the spots towards the anal angle and on the inner margin up to the base with grey.

Underside. Anterior wings creamy white, base and apex buff; a few indistinct grey spots across the disk near the outer margin. Posterior wings buff.

Expanse of wings $1\frac{7}{8}$ inch.

Near to *Lasti*.

Callosune anax.

Male.—*Upperside*. Anterior wings white with black veins, except the subcostal and median nervure and the upper discocellular nervule, which are brownish white; apical third with a large iridescent mauve patch, in some lights iridescent blue, broadly bordered with black all round, especially towards the inner angle; a narrow oblong spot at the end of the cell; basal area grey. Posterior wings white, with the outer half of the veins black, tipped at the ends with rather large triangular black spots.

Underside. Anterior wings white, with partially black veins, as on the upperside, tipped with black; outer margin black, the mauve colour in the patch on the upperside showing faintly through, in the middle of which between the veins is a curved row of five triangular black spots, the apices of the triangles pointing inwardly; the first spot beneath the second subcostal nervule, the middle spot the largest, a spot at the end of the cell. Posterior wings creamy white, with brown veins, tipped on the margin with black; on the disk is a row of black spots between the veins, the first below the costa, rather beyond its middle, the largest, the three next in a line beneath the first, the three lowest following the curve of the wing towards the inner margin; a small spot at the end of the cell crowned with orange; basal third of the costal margin orange.

Female.—*Upperside*. Both wings white. Anterior wings with apical third black, internally dentate towards the inner angle; basal third irrorated with black scales, the apical patch

traversed by a curved row of six white spots between the veins, inside which is a row of three mauve spots; a round spot at the end of the cell and another above the submedian nervure towards the anal angle. Posterior wings with a row of large triangular black spots at the tips of the veins almost contiguous; base grey.

Underside. Anterior wings white, apical third pale yellow, traversed by the broadly black veins from the outer margin as far as a row of confluent, broad, black spots, beyond which is a greyish area; a spot at the end of the cell, another near the inner angle, as on the upperside. Posterior wings creamy yellow, shaded with orange near the inner margin and on the costa; tips of the veins black, shaded on each side with grey, the black extending along the veins almost as far as the discal row of spots, which are larger than in the male; a small spot at the end of the cell crowned with orange.

= Expanse of wings, ♂ $2\frac{1}{2}$, ♀ $2\frac{3}{8}$ inches.

Nearest to *bacchus* and *imperator* of Butler, but very distinct from each of them. It is the largest of the group.

Acræa cuva.

Male.—Upperside. Both wings semitransparent, bright rosy brown to the extent of two thirds of the anterior and four fifths of the posterior wings, round the outer margin of which latter is a clear, rather broad, transparent, marginal space. Posterior wings with an irregular row of eight black spots beyond the middle, the fourth the outermost; the fourth, seventh, and eighth towards the anal angle the smallest.

Underside. Posterior wings with spots as above, but rather larger, and a cluster near the base, which are indistinctly seen on the upperside.

Expanse of wings 2 inches.

Nearest to *Dammii*, Voll.

Acræa makupa.

Upperside. Both wings semitransparent brown. Anterior wings with base, costal margin, a large spot across the middle of the cell, a transverse band of confluent spots at the end of the cell from the middle of the costa to the inner angle, a curved band of similar spots beyond, broadest on the costa, narrowest near the inner angle, where it joins the preceding band, the outer margin and the veins, dark brown. Posterior wings crossed beyond the middle by an irregular curved band, which, with the veins and margins, are dark brown.

Underside as above ; but on the posterior wings the space between the base and the curved band is irrorated with whitish brown.

Expanse of wings $2\frac{1}{4}$ inches.

I am not aware of any African *Acræa* which resembles this species ; but it has a general resemblance to *A. alulia*, Feld., from South America.

Acræa mombasæ.

This butterfly strongly resembles *A. rabbaïæ*, Ward ; but a uniform series of them discloses a sufficient difference to warrant it being considered a distinct species.

Both wings are transparent pale brown, the nervures, a broad space at the apex and round the outer margin of anterior wings, and the posterior wings darker brown ; the irregular band of spots across the middle and the spot below the cell of anterior, and the submarginal band of posterior, wings brownish grey and much less distinct than in *rabbaïæ* ; the marginal band on posterior wings broader and growing nearly obsolete towards the anal angle ; the markings and nervures in *rabbaïæ* are much darker, almost black, and more distinct ; the spot below the cell on anterior wings is larger, the submarginal band on posterior wings is brighter and more completely defined towards the anal angle.

Mombasæ may be a seasonal or local form of *rabbaïæ*.

Expanse of wings, ♂ $2\frac{1}{2}$, ♀ $2\frac{2}{3}$ inches.

Acræa matuapa.

Male.—Upperside. Anterior wings semitransparent, the basal half clouded with pale buff ; apex dusky brown, a number of spots across the wing which are variable, as in *neobule* and *hirta*. Posterior wings pale brown, with a broad brown-black margin, in the middle of which is a row of small pale brown spots between the nervures, almost obsolete ; the spots on the disk and at the base vary in number and size.

Underside as above, the spots on the broad marginal border of posterior wings more distinct, but minute and almost white.

The female resembles the male, but is paler and larger.

Expanse of wings, ♂ $2\frac{1}{8}$, ♀ $2\frac{5}{8}$ inches.

Differs from *neobule* chiefly in the much greater breadth of the band on the posterior wings and the smallness of the spots in that band.

Acræa khara.

Male.—*Upperside.* Both wings bright reddish brown, shaded towards the base with black; a black band on the outer margins of both wings, broadest at the apex of anterior wings. Anterior wings: costa broadly black, shaded with black towards the apex; a spot across the cell, another at the end, beyond which is a cluster of three spots, confluent; beyond this a pale pinkish space, semitransparent; below the cell are two spots close to the nervures, one near the base, the other halfway between and below the two cellular spots; below the last-named is another spot; the spots, and nervures especially towards the apex broadly, black. Posterior wings with a cluster of spots from the centre to the base.

Underside. Anterior wings reddish brown, dusky towards the apex; costa and outer margin narrowly black: nervures from the middle of the wings black. Posterior wings brown, shaded towards the middle with pale and at the base with darker pink; spots and marginal band as above, the latter with a row of pale, narrow, oblong spots between the nervures.

Expanse of wings 3 inches.

Near to *agina*, but brighter, less transparent, and it has a very distinct black band on outer margin of anterior wings.

Acræa bomba.

Male.—*Upperside.* Both wings bright brown. Anterior wings with apex broadly dark brown; four spots of same colour, one in the cell, one at the upper end of cell, the third below the second outside the cell, and the fourth towards the inner angle. Posterior wings with a rather broad dark brown marginal band, with five small light brown spots on the margin towards the anal angle; an irregular row of seven spots round the disk, two spots in the cell, and several small spots near the base.

Underside. Anterior wings paler brown, lighter towards the apex, an additional spot beyond the middle; costa, outer margin, and ends of the nervures near the apex black. Posterior wings pinkish brown, mottled between the spots and beyond the middle with pale brown; the dark brown marginal band with pale brown oval spots between the nervures; ends of the veins, nearly as far as the middle, black.

Expanse of wings $1\frac{1}{2}$ inch.

Hab. Namoule.

Nearest to *acrita*, Hew.

Pseudacreea simulator.

Male.—*Upperside.* Both wings slightly transparent, brownish black, with black veins and spots at the base. Anterior wings with a rufous-brown patch extending over the lower third of the cell and to the inner margin nearly to the inner angle, and a broad, irregular, oblique band of same colour from halfway along the costa, but a little below it, to near the outer margin. Posterior wings: costal and outer margins rather broadly brownish black, black lines between the veins extending towards the cell; the rest of the wings rufous brown.

Underside. Both wings as above, but paler. Posterior wings with the base, basal portion of the cell, and basal half of the costal area chocolate-brown.

Female.—*Upperside* resembles *imitator*, Trimen, and *eurytus*, Clerck, but differs from the former in having a conspicuous white band on the inner margin of anterior wings, and from the latter in the broader subapical band on anterior wings and in the much larger extent of the white area of the posterior wings.

Underside.—The basal chocolate-brown area of posterior wings is smaller and narrower than the brown area, and the white area is broader than on the undersides of either *imitator* or *eurytus*.

Expanse of wings, ♂ $2\frac{1}{2}$, ♀ 3 inches.

The male somewhat resembles the male of *dolomena*, Hew. In some specimens of *simulator* the rufous-brown area below the cell on anterior wings is confluent with, instead of being narrowly separate from, the oblique subapical band. If the female had corresponded in all respects with Mr. Trimen's figure of *imitator*, female, I should have assumed the male above described to be the male of that species, which I believe is unknown.

Euxanthe tiberius.

Upperside. Anterior wings with three rows of greenish-white spots, the first row transverse across the middle of the wings with five spots, the first within the cell at its upper extremity triangular, with apex downwards, the second beyond the cell larger, the third about same size below it, the fourth the largest, oblong, scarcely extending below the cell on its inner side, the fifth towards the inner angle bifid; the second row halfway between the first and third rows irregular, with eight spots; first spot near the costal margin oval, the next narrower, the third and fourth oval, about same size

as the first, followed by four smaller round spots, the lowest at the inner angle the smallest, the third row near the apex with five spots, the second the largest, the fifth the smallest; a large patch of brown at the base extending over two thirds of the cell and below it, but not reaching to the first row of spots. Posterior wings with a submarginal row of small white spots, inside which towards the apex are four round spots, the second the largest; the middle of the wings and two thirds of the cell occupied by a large greenish-white patch, the lower edge irregular and intersected by the dark brown nervures running partially up it towards the cell.

Underside as above, but browner, the middle of the anterior wings and a rather broad marginal band on posterior wings containing the marginal row of spots is black; the rest of the posterior wings is brown with black veins and streaks between; spots as above, several white spots near the base.

Expanse of wings $3\frac{7}{8}$ inches.

Near to *trajanus*, but differs from it chiefly in the position, shape, and colour of the spots in and about the cell, in the middle row of spots on anterior wings, and in the absence of the pale streak along the inner margin of those wings.

Charaxes calliclea.

Male.—Upperside. Both wings velvety black, with a very broad marginal band of reddish brown; the upper third of the band on anterior wings is intersected by the black veins and furcate, the inner side of the band curving inwardly to near the costal margin, the outer side extending to the apex, thence turning at a sharp angle a short distance along the costa; a minute black spot centred with white at the anal angle; margins black, emarginate on the posterior wings, which have one short tail.

Underside brownish red, sericeous on the anterior wings, except the outer third, and on the posterior wings except a rather broad irregular band which crosses the wings beyond the middle and a marginal narrow band beyond the submarginal row of spots. On anterior wings three broadish bars across the cell, a central row of broadish markings beyond and a shorter one under the cell almost black at the bottom, another row halfway between the central row and the outer margin all dark reddish brown, two greyish-sericeous spots at the apex, a dark patch near the inner angle. On posterior wings a submarginal row of small pale spots terminating at the anal angle, with two small black spots crowned with white.

Female.—*Upperside.* Both wings dark brown, with broad bright brown margins, crossed from the middle beyond the cell of anterior wings by a white patch, greyish towards the base, tinged with pale brown on its outer edge; the patch commences on the uppermost median nervule of anterior wings, widening rapidly to the inner margins and extending over the inner two thirds of the posterior wings, except near the base, which is dark brown; above the top of the patch on anterior wings beyond the cell are two light brown oblong spots, and halfway between these and the outer margin is a curved row of light brown conical spots, paler on the inner edge and fading at the lower end into the white patch. Posterior wings: two small spots at the anal angle and two tails, the uppermost the longest, margins black.

Underside. Both wings with basal third reddish brown and darker streaks; the white patch on the upperside represented by a pale yellowish-brown area, bordered outwardly on posterior wings with darker brown. On the anterior wings between the lowest median nervule and the submedian nervure a U-shaped black spot, an indication of the two oblong spots and the curved row of light brown conical spots on the upperside; a dark patch centred with grey near the inner angle. Posterior wings with a row of small light spots between the veins near the margin and two dark spots crowned with grey at the anal angle.

Expanse of wings, ♂ $3\frac{2}{3}$, ♀ $3\frac{1}{2}$ inches.

Nearest to *protoclea*, Feist., and *anticlea*, Drury.

Charaxes Lasti.

Male.—*Upperside.* Both wings brown, outer margins emarginate. Anterior wings with an irregular dark brown submarginal band of confluent spots, widest at the apex, gradually tapering to the inner angle; across the middle are two rows of dark brown spots, the row nearest the cell with five spots, the fifth nearly obsolete, situate between the lowest median nervule and the submedian nervure; the other row, nearer the submarginal band, with five spots, the fifth situate below the first median nervule the smallest, the fourth sagittate, extending over the space between the two rows, the three upper spots confluent; a small hook-shaped dark brown spot partly at the end of, partly beyond the cell; the veins between the outer row of spots and the submarginal band, also between the latter and the outer margin, broadly dark brown. Posterior wings with a submarginal row of dark brown spots, the second the largest, the lower spots dimin-

ishing and gradually becoming almost obsolete towards the anal angle, where there are two small spots crowned with grey; the basal third part of the wings darker brown.

Underside. Both wings brown. Anterior wings with reddish-brown spots across the cell, a row of same colour about halfway across the wings, terminating in a large spot above the submedian nervure, formed by two blackish-brown bars, the space between which is grey; a bifid spot outwardly incised with grey near the inner angle; the costa from the base halfway along the wings silvery white. Posterior wings crossed from the middle of the costa to near the anal angle by a silvery-white line, edged internally with dark brown, several light reddish-brown markings on each side of the line, a submarginal row of small grey spots, two spots at the anal angle surrounded with grey.

Female.—*Upperside.* Both wings brighter and lighter than in the male; the basal third of anterior and basal and outer thirds of posterior wings darker, the markings as in the male, but more strongly developed, and the hook-shaped spot at the end of cell of anterior wings is represented by a broad bar beyond the end of the cell.

Underside much paler, the light red markings across the cell and the basal third of the wings more clearly defined.

Expanse of wings, ♂ $2\frac{6}{8}$, ♀ $3\frac{3}{8}$ inches.

On the underside this insect somewhat resembles *cynthia*, Butler.

Charaxes nescea.

Male.—*Upperside.* Both wings bluish black. Anterior wings falcate, crossed beyond the cell by two rows of blue spots, the inner row halfway across the disk, with the four upper spots tinged with white and terminating in a broad triangular blue patch, the base of which extends over the middle half of the inner margin; the outer row of six small blue spots follows the curve of the outer margin and is situate about halfway between it and the inner row; a small whitish-blue spot at the end of the cell; costa and veins brown. Posterior wings crossed from the middle of the costa to near the anal angle by a broad whitish-blue patch, palest towards the abdominal margin; a quadrangular white spot between the costal nervure and the first subcostal nervule about the middle; a submarginal row of small whitish-blue spots, between which and the outer margin towards the anal angle is a thin blue line.

Underside. Both wings pale dirty brown, with sundry

blackish markings. Anterior wings with a very marked irregular, crescent-shaped, blackish spot between the lowest median nervule and submedian nervure towards the base, and an indistinct spot above the submedian nervure near the inner angle. Head and thorax black. Abdomen bluish white.

Expanse of wings $2\frac{7}{8}$ inches.

There is a very slight indication of a tail on posterior wings, and in this respect, as well as in the falcate shape of anterior wings, this insect approaches *mycerina*, Godt., *nesiope*, Hew., and *porthos*, Grose Smith.

Euryphene kinugnana.

Male.—*Upperside.* Both wings brownish black, crossed from the middle of anterior wings to near the anal angle by a broad band of buff-colour. Anterior wings with three oblong spots beyond the cell above the band and of same colour, beyond which are four small buff spots, followed by a submarginal row of U-shaped whitish lines, more developed towards the apex, almost obsolete at the inner angle; three indistinct markings in the cell. Posterior wings with a similar submarginal row of U-shaped lines.

Underside. Both wings much paler and browner, the band across both wings white. Anterior wings with two black reniform spots edged with white centred with brown, one across the middle, the other at the end of the cell; another spot black edged with white below the cell near the base, the other markings more strongly defined. Posterior wings with a small brown spot centred with white near the base of the cell, on each side of which is a white streak curving outwardly.

Female.—*Upperside.* Both wings ashy grey, the band, lines, and spots white, and more distinct than in the male; the band on anterior wings almost bisected on the inner side, and on posterior wings broader.

Underside as in the male, but whiter.

Expanse of wings $1\frac{6}{8}$ inch.

Approaches *elabontas*, Hew., but in shape resembles an *Apatura*, to which genus it may possibly belong.

Cymothoë coranus.

Male.—*Upperside.* Both wings stramineous white, broadly bordered with cinereous brown, the border edged internally between the veins with dark brown hastate markings, those on anterior wings mostly confluent with the border; on the

posterior wings more distinct; base of both wings and marginal fold of posterior wings dusky brown, the markings on the underside showing through.

Underside. Both wings stramineous, with numerous light brown markings; a straight brown line traverses both wings, as in *cænis*, Drury, except that near the costal margin of anterior wings the line sharply curves inwardly, where in *cænis* it is straight.

Female.—*Upperside* strongly resembles female of *cænis*, but it is larger and blacker; the central white band is broader and, at its upper end, more curved inwardly.

Underside much whiter and markings more distinct; the central line on posterior wings has a decided curve inwardly.

Expanse of wings, ♂ $2\frac{2}{5}$, ♀ $2\frac{6}{8}$ inches.

Near to *cænis* and *amphiceda* as well as *alcimeda*, Godt., but differs as above indicated, and in the male in the entire absence on both wings of any row or portion of a row of markings inside the submarginal hastate markings.

Larinopoda peucedæ.

Male.—*Upperside.* Both wings transparent white, broadly bordered on costal and outer margins of anterior and outer margin of posterior wings with greyish semitransparent black; an oblique broader band with a confluent spot at the lower end of same colour crosses the anterior wings from the middle of the costa to a little below the middle of the outer margin; there is a large round spot of same colour at the end of the cell of posterior wings, partly within and partly outside it, with two small spots on the underside showing through; base same colour.

Underside. Both wings as above, but blacker, and on posterior wings there are two small spots, one near the costa towards the base nearly obsolete, the other near the inner margin, in a line with the central spot.

Expanse of wings, ♂ $1\frac{5}{8}$, ♀ $1\frac{6}{8}$ inch.

Resembles *peucea*, Hew., but is a larger and blacker insect.

Chrysorychia punicea.

Male.—*Upperside.* Anterior wings dark brown, with a reddish prune-coloured patch commencing in the middle rather above the upper median nervule, gradually widening to the inner margin; costa on the shoulder brown. Posterior wings with a patch of similar colour occupying the lower

outer half of the wings; the base, a space halfway down the inner margin, and the costal margin broadly dark brown.

Underside. Pinkish brown; two spots in the cell, one beyond it, two in a row underneath the last-named spot, several spots in a row following the costa, and an elongated spot at the apex golden, edged with black, a submarginal row of spots slightly golden; near the inner margin about the middle is a silvery-white line slightly curving towards the inner angle, and between this and the base is another similar line but shorter and thicker. Posterior wings with numerous small gold markings and a row of same on the outer margin of the lower half of the wings; the excavation above the anal lobe with a submarginal golden line.

Female.—Upperside. Both wings orange-brown. Anterior wings with costal and outer margins and base broadly dark brown; shoulder broadly pale orange-brown; cell dark brown, mottled with orange-brown, a dark spot at end. Posterior wings, base, costal and upper portion of the outer margins broadly dark brown.

Underside pale orange-brown, gradually becoming paler towards the inner margin of anterior wings; the spots as in the male, but larger, as are also the two curved lines on the inner margin of anterior wings.

Expanse of wings, ♂ 1, ♀ $1\frac{1}{4}$ inch.

Chrysorychia mendeche.

Male.—Upperside. Both wings fuscous. Anterior wings with an orange-red discal band, broad at the apex immediately below upper median nervule, and two spots in the cell of same colour; shoulder broadly orange-red. Posterior wings same colour, except near the base, which is fuscous.

Underside. Both wings reddish brown. Anterior wings paler beneath the cell, and thence to the inner margin; costa on the shoulder broadly pale yellowish brown; cell crossed by two spots, two beyond, two near the base on the inner margin, all gold bordered with black; a submarginal row of dark spots, another towards the middle, slightly golden, below which, halfway between it and the two gold spots at end of cell, is another spot, slightly golden, as are also several spots along the costa. Posterior wings with numerous dark spots and markings, not metallic, except the line above the anal excavation.

Female light orange-brown, with a broad brown band along the outer margin, slightly wider towards the apex; costal margin powdered with brown; shoulder pale brown; a

dark brown spot in the cell, an elongated transverse bar beyond the cell; in the centre of the disk between the median nervules are three or four small round spots. Posterior wings with a submarginal row of spots, inside which is a row of three spots, the first below costal nervure towards the apex, the next at the end of the cell, the third below the second; one or two indistinct markings near the base, which is dusky brown.

Expanse of wings $1\frac{1}{4}$ inch.

Near to *harpax*, Fabr., and *ananga*, Westw.

Aphneus zanzibarensis.

Male.—*Upperside.* Anterior wings dark brown, the basal area halfway across the cell, thence in an oblique line to near the anal angle, and three fourths of the inner margin metallic light blue; a round white spot at the end of the cell, a curved row of five similar spots across the disk, the central one being out of line, much nearer the outer margin; a subapical white spot; a red line near the inner angle; shoulder broadly reddish brown. Posterior wings paler than anterior; the central and upper part of wings, except a rather broad space at the base and round the costal margin, metallic light blue.

Underside. Both wings brown, paler at the outer margin, with numerous silver spots edged with dark red. On the anterior wings a large spot on the shoulder, a small one under it in the cell, beyond which, following the costa and extending inwardly to one third the width of the wings, are three large spots, oblong, one being across the cell, the next at the end, partly within and partly without, the next halfway between it and two subapical confluent spots; three submarginal spots, the first distinct, the lower two confluent; a large oblique spot in the lower middle part of the wing, extending downwards until it fades into the pale region of the inner margin. Posterior wings: a large spot at the base, two others, large, along the costal margin, a small round spot in the cell, another, large, irregular, at the end; a row of six spots beyond, the first two and the fourth small, the third larger, oblong, the fifth elongated and curved at its lower end, the sixth nearly round, halfway up the inner margin; several small spots near the anal angle. Outer margins of both wings black, with black and white cilia; antennæ tipped with light brown.

Expanse of wings $1\frac{1}{2}$ inch.

On the upperside somewhat resembles *somalina*, Butl., but very different on the underside.

Iolaus silanus.

Male.—*Upperside.* Both wings bright blue. Anterior wings: apical third, from the middle of the costa down to the end of the lowest median nervule, black, whence to the inner angle the margin is narrowly black; shoulder grey. Posterior wings with black apex and margins narrowly so; cilia white; costal margins white, the costal, shining, circular space steel-grey; a black spot crowned with red at the anal angle, above which, extending inwardly, is a rather short, black, linear marking and two small black spots below it near the margin between the tails.

Underside silvery white. Anterior wings with a narrow black line across the end of the cell, beyond this another black line extending from near the costa two thirds across the wings, outside which and extending rather lower down the wing is an interrupted faint black line. Posterior wings with a narrow black line beyond the middle, curving at the lower end to the inner margin, between which and the outer margin is another line, interrupted near the anal angle by two spots, that nearest the angle metallic blue on the margin, above black, the other between the second and third tail black, both spots and the space above and between crowned with yellowish red; an interrupted faint black line near the outer margin between the upper spot and the apex; margins and tails black, the latter tipped with white, cilia white.

Female.—*Upperside.* Anterior wings pale blue, shaded with grey towards the base and white in the middle; apical third greyish black; shoulder grey. Posterior wings: the lower three fourths blue, shaded with grey and mottled with white towards the outer margin; the costal and apical region grey; the innermost dark line on the underside is represented by an undulated, narrow, dark grey line across the disk beyond the middle, curving at the bottom towards the inner margin until it merges in a greyish-black, rather broad band, which crosses the lower end of the wings; a black spot at the anal angle crowned with red; two rather broad blackish bars between the tails, a narrow white line inside the black outer margin.

Underside as in the male, but the lines rather more distinct.

Expanse of wings, ♂ $1\frac{1}{2}$, ♀ $1\frac{3}{8}$ inch.

Near to *silas*, Westw., and *silarus*, Druce, but has, on the underside, a black line at the end of the cell on anterior wings and an additional discal line on both wings; the male is a lighter blue on the upperside, and the females are different.

XV.—*Remarks in reply to Dr. Baur's Article on the Systematic Position of Miolania* *. By G. A. BOULENGER.

AFTER having thought *Miolania* to be allied to *Staurotypus*, Dr. Baur now regards this Chelonian as representing "a highly specialized branch of the true land-tortoises, the *Testudinidae*, the true *Testudinid* characters of which are only obscured by the enormous development of dermal ossifications, especially on the skull, which gave to it quite an extraordinary appearance." Dr. Baur's argumentation, based to a great extent upon extremely doubtful data, has not in any way modified the view I arrived at, viz. that *Miolania* was a Pleurodiran—not of course a member of any of the existing groups, but the representative of a distinct very specialized family of terrestrial habits. The idea that a Reptile with a long tail, with opisthocœlous vertebræ and large chevron-bones, can be descended from the short-tailed forms which constitute the Pleurodira at the present day is inadmissible; and so is Dr. Baur's theory of the specialization from a land-Testudinoid, viz. a type with extremely reduced tail, with procœlous vertebræ and no chevrons.

For the reason that *Miolania* constitutes a family different from any of the known Pleurodira, and led a terrestrial instead of an aquatic life, it is not to be expected that we should obtain an exact repetition of all the characters which we observe in the existing types. In his definition and enumeration of those characters Dr. Baur has arrived at some curious misconceptions from not examining sufficient material, and, what is still less excusable, by not carefully perusing the standard works on the osteology of Reptiles. Thus, for example, he entirely ignores the cranial structure of *Chelys*, the type, in a systematic sense, of the Pleurodira, which has been figured by Cuvier, Wagler, Brühl, Hoffmann, and Mivart. He will find, by referring to *Chelys*, that his character of "the quadrate connected with the basisphenoid, sometimes with the basioccipital," falls to the ground. That the connexion between the vomer and the præfrontals does not exist in the living Pleurodira is perhaps due to the fact that the vomer is absent in the Pelomedusidæ, whilst in the Chelydidæ, where it is present, the præfrontals are widely separated from each other; however, in *Chelys* and *Chelodina* a complete bony orbito-nasal septum is formed by connexion of the præ-

* January number of these 'Annals,' p. 54.

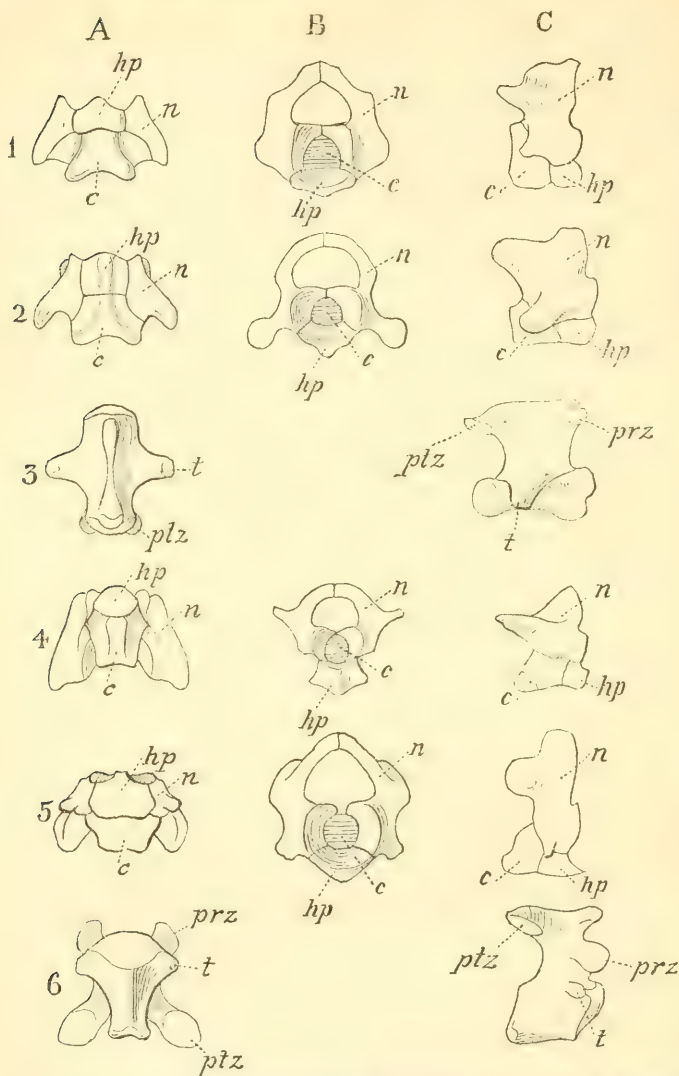
frontals with the palatines. Besides, the fact that in the Trionychoids the bony connexion between the præfrontals and the vomer may be present or absent, is sufficient to warn us against attaching great importance to that character. And, moreover, Dr. Baur is not justified in saying that the præfrontals are connected with the vomer in *Miolania*, since, so far as the material in the British Museum shows, the connexion may have been just as well with the palatines, as in the above-named Pleurodira.

Having studied the palate on the original specimen of *M. platyceps* (Owen, Phil. Trans. 1888, pl. xxxii.), now in Sydney, I claim to be better informed as to the condition of the pterygoids than my critic, who, after examining merely the cast, thinks the lateral expansion of the pterygoids "may be produced by crushing of the edges." I can confidently state that the left pterygoid figured by Owen (*l. c.*) is intact, and also that such a shape as it shows is not to be found in *Testudo* or in any other Cryptodiran (exclusive, of course, of the Trionychoids). Owing to the condition of the fossils I have no right, any more than Dr. Baur, to be absolutely positive in my statement respecting the posterior extension of the pterygoids; but after a careful comparison with numerous types of Cryptodiran and Pleurodiran Chelonians, it seems to me extremely probable that the quadrate did join the basisphenoid, as in *Podocnemis*. I have already indicated the reason (P. Z. S. 1887, p. 554) why the pterygoids are not turned up in *Miolania*.

The back of the skull of *Miolania* is as typically Pleurodiran as can be, and totally different from that of the Testudinidæ. A complete bony ring, which I decidedly hold to be formed by the quadrate, surrounds the ear-opening, and the ear-chambers are otherwise completely open behind.

How Dr. Baur has acquired his information respecting the characters of the Pleurodiran cervical vertebræ as compared with the Cryptodiran is a puzzle to me, for it is not borne out by an examination of the osteological collection in the British Museum. Better than any lengthy discussion, the following figures will show whether Dr. Baur is justified in stating that an "atlas-ring" is absent in the Pleurodira and that the centrum alone supports the neuroids of the atlas. I particularly request a comparison of these figures with his definition of the supposed distinctive characters of the Pleurodiran and Cryptodiran atlas.

With regard to *Miolania*, I can state that the neuroids of the atlas are supported by both the hypapophysis (first intercentrum) and the centrum, that the latter articulated



1. First cervical vertebra of *Elseya dentata* (Pleurodiran). 2. First vertebra of *Podocnemis madagascariensis* (Pleurodiran). 3. Second vertebra of same. 4. First vertebra of *Morenia ocellata* (Cryptodiran). 5. First vertebra of *Testudo polyphemus* (Cryptodiran). 6. Second vertebra of same.

A. Lower view. B. Front view. C. Lateral view.

c. Centrum. hp. Hypapophysis (first intercentrum). n. Neuroids. t. Transverse processes. prz. Præzygapophyses. ptz. Postzygapophyses.

freely with the second centrum, and that the diapophyses of the second vertebra are not partly below the præzygapophyses, as in all Cryptodira, but entirely behind; in all these respects agreeing with the vertebræ of *Podocnemis madagascariensis* figured above. Two adult skeletons of *Testudo polyphemus* are in the Museum; they do not show the slightest resemblance to *Miolania* in their first and second vertebræ, and, in addition to their position, the diapophyses of the latter differ in not being half so much developed.

Dr. Baur wonders "how Mr. Boulenger could compare the cervicals of *Miolania* with those of *Chelys*." He misinterprets the meaning of my words:—"The cervical vertebræ [of *Miolania*] are those of a Pleurodiran; a strong and long transverse process is present, and the posterior borders of the odontoid bone and of the second centrum are deeply emarginate inferiorly, terminating in two diverging processes, as in *Chelys*."

If Dr. Baur were acquainted with the structure of the hyoid in the Pelomedusidæ he could not have pointed to the character of the hyoid bones as proving the Testudinoid nature of *Miolania*.

XVI.—*The new Flora of Krakatao.* By M. TREUB*.

AVERSE though I am to preliminary communications †, I feel compelled to make an exception in the present instance, and this for two reasons. First, because absolutely nothing is known of the manner in which a volcanic island becomes clothed with an entirely new vegetation; secondly, because the data which I am able to furnish on the new flora of Krakatao are definitely acquired at the present time; there is no fear of their being invalidated by subsequent researches.

It is owing to the kindness of M. R. D. M. Verbeek, chief engineer of mines, a learned geologist and the well-known historiographer of the eruption of Krakatao, that I have been

* Translated from the 'Archives des sciences physiques et naturelles,' Dec. 15, 1888.

† This notice contains an abstract of a communication made by the author to the Academy of Sciences of Amsterdam at its meeting of the 28th January, 1888. "I intend to visit Krakatao again, in company with my friend Dr. W. Burek. I hope that we shall be able in time to publish a work in detail on the new flora of the island."

able to visit the island, nearly three years after it had been the theatre of the terrible calamity.

The information concerning Krakatao obtained from navigators about this period left doubts existing on the question essentially interesting to botanists, namely whether the island again showed a commencement of vegetation. Some maintained that the thick layer of pumice-stone which covers it was bare and everywhere barren. Others affirmed, on the contrary, that they had distinctly recognized plants of some height, here and there, by the aid of telescopes.

When we drew near to Krakatao on the morning of the 19th of June, 1886, we were not long in distinguishing a fair number of plants; and this not only near the sea-level, but likewise on the heights and even towards the summit of the island.

It is necessary to say in this place that the existing island—that is to say, the part which has remained after the eruption *—has the form of a mountain standing by itself in the sea, rising on one side almost perpendicularly to an altitude of about 2500 feet. The slopes of the opposite side are much more inclined, but nevertheless fairly precipitous. The beach is very narrow; at the foot of the huge, almost perpendicular wall there is none at all.

Before enumerating the plants which I have found at Krakatao, and before entering into any discussion on the subject of this new flora, we must first of all briefly consider two points.

In the first place it is indispensable to prove that the existing flora must be regarded as new and that it has not arisen from the remains of the luxuriant vegetation which covered the island before the eruption. Nothing is easier, however, than to furnish this proof. At the time of the eruption the trees, thrown down or broken by the violent gusts of wind, must have been half carbonized, considering the extremely high temperature which undoubtedly prevailed over the whole island.

Afterwards Krakatao was covered from the summit to well below the sea-level with a layer of ashes and of burning pumice. This layer has a thickness varying from 1 to 60 metres. Under such conditions it is clear that no vestige of the flora could have existed after the cataclysm. The most persistent seed and the best protected rhizome must have for ever lost all vitality.

* The great eruption of Krakatao took place from the 26th to 28th of August, 1883.

There is no need to discuss the possibility of the plants newly installed at Krakatao having been brought there by the intermediation of man. The island is uninhabited, uninhabitable, and difficult of access.

Finally, the composition itself of the existing flora of Krakatao is an additional proof that it cannot have derived its origin either from the former flora or by the intervention of man.

In the second place I think it necessary to say a few words on the views generally adopted as to the origin of the floras of islands. This question, justly regarded as one of the most important in botanical geography, has been treated in a number of works and memoirs of great value. It would be out of place in this short notice to make numerous quotations; nevertheless I cannot refrain from mentioning the excellent memoirs on insular floras and their origin published two years ago by Mr. W. Botting Hemsley of Kew. In these memoirs, which together form the first volume of the "Botany" part of the celebrated 'Challenger' Reports, Mr. Hemsley has brought together and discussed all the data bearing on the subject.

Everything to be found in literature on the origin of insular floras has reference to coral-islands: these are the only ones for which direct observations have been possible up to the present time.

When one of these islands has begun to rise above the level of the sea, seeds carried by ocean-currents from distant shores strike against the growing island. Arrested for good and all in their passive course these seeds germinate and give birth to the first vegetation of the island. That seeds and fruits may play this rôle of first colonizing agent they must be able to float for a long time in the sea and must not lose their germinative power. These two qualities being rarely united, the number of plants which land on one of these new coral-islands is very restricted. It is always the same plants, generally trees, to which the rôle of first colonizing agent reverts; there are at the most thirty species in all which come under consideration.

Once the isle is provided with some trees a second colonizing agent intervenes. It is birds, and amongst them especially oceanic pigeons (frequently *Carpophaga oceanica*), which now act this rôle, by coming to rest on the trees after their long flight. Being frugivorous, they deposit on the island with their excrement the seeds of many plants, which are not long in constituting a new and important element of this flora *in statu nascendi*. Ocean-currents and birds are thus the two agents

to which newly emerged coral-islands are indebted for their floras. The wind or fortuitous causes may bring spores or seeds of other plants later on ; but these latter will then find the soil prepared by their predecessors brought by the sea or by birds.

Now, how does a lofty volcanic island, a mountain which has sprung suddenly out of the sea at the time of an eruption, clothe itself with plants? Or, which comes to the same thing for the botanist, How does a volcano forming an island, having lost all its vegetation by an eruption, acquire a new flora? These questions have never been put in a categorical manner so far as I know. It is not to be wondered at, since only quite hypothetical answers could have been given.

Nobody up to the present time has been in the position of witnessing the advent of a new flora on a volcanic island.

After the knowledge acquired on the origin of coral-island floras I do not think I shall be deviating too far from the truth in assuming that the advent of a flora on one of these volcanic islands should be depicted in the following manner. The littoral of the island becomes covered with plants by the aid of seeds brought by ocean-currents and by birds in just the same manner as with coral-islands. The elements which compose the flora of this littoral belt will ascend little by little the slopes of the island ; this is possible, since the majority of these plants, although preferring a saline station, yet grow vigorously at a distance from the shore and at a tolerably great altitude. However, the further the original vegetable belt of the shore ascends, the more its progress slackens. Lastly, it will be almost entirely by the mediation of birds that the most elevated parts of the island will be stocked with plants. When once the whole island is covered with a vegetable carpet, as yet not very dense, the soil will be prepared little by little for the reception of other plants, the spores or the seeds of which are brought by the wind or by other agents.

Let us now return to Krakatao to see what we learn from the reality.

It is clear, after all that has been said, that a distinction must be made between the flora of the shore and that of the mountain proper, since we already know that there are plants on Krakatao up to an altitude of more than 2000 feet.

I visited Krakatao on two occasions between the 19th and 24th June, 1886. On the shore I collected seeds or fruits of the following plants :—

Heritiera littoralis, *Dryand.* (1).

Terminalia catappa, *L.* (2).

Cocos succifera, *L.* (1):

Barringtonia speciosa, *L.* (5).

Calophyllum inophyllum, *L.* (3).

Pandanus, *sp.* (1).

The figures after the name of the plants indicate the number of fruits and seeds collected. Subsequently I found on the shore some young shoots of the following species :—

| | |
|----------------------------|---------------------------|
| Erythrina, sp. | Two Cyperaceæ. |
| Calophyllum inophyllum, L. | Ipomœa pes-capræ, Sw. |
| Cerbera odallam, Gaertn. | Gymnothrix elegans, Buse. |
| Hernandia sonora, L. | Scaevola Koenigii, Vahl. |

As was to be supposed, all the plants and seeds met with on the littoral of Krakatau, with the exception of *Gymnothrix elegans*, a grass common in Java, belong to the list of species which stock newly emerged coral-islands.

In the interior of the island, upon the mountain proper, I found the following species :—

PHANEROGAMS.

| | |
|--------------------------------|---------------------------------|
| Wollastonia, sp. | Gymnothrix elegans, Buse. |
| Two species of <i>Conyza</i> . | Phragmites Roxburghii, N. ab E. |
| Senecio, sp. | Tournefortia argentea, L. |
| Scaevola Koenigii, Vahl. | |

FERNS.

| | |
|---------------------------------|------------------------------|
| Gymnogramme calomelanos, Kaulf. | Nephrodium calcaratum, Hook. |
| Blechnum orientale, L. | — flaccidum, Hook. |
| Acrostichum scandens, J. Sm. | Pteris aquilina, L., var. |
| — aureum, Cav. | — marginata, Bory. |
| Pteris longifolia, L. | Onychium auratum, Kaulf. |
| Nephrolepis exaltata, Schott. | |

The determination of the Ferns is due to the kindness of Dr. W. Burck.

The list gives rise to the following observations.

First, it is seen that the new flora of the interior of Krakatau * is entirely different from that of the littoral, since there are only two species met with both on the shore and the mountain. Then the presence of four species of Compositæ merits notice. It can hardly be doubted that their seeds have been carried to Krakatau by the wind, contrary to the opinion generally held in botanical geography, according to which the seeds of Compositæ have hardly ever been known to be

* I also found two mosses on Krakatau. Having sent them to Dr. v. d. Sande Lacoste at Amsterdam with a request that he would determine them, I hoped to learn their names on my return to Europe. On arriving in Holland I became acquainted with the sad news of the death of Dr. v. d. Sande Lacoste, which had taken place during my voyage to Europe. It will be sufficient to state here that the two mosses in question do not play any important part in the restocking of Krakatau.

transported by the wind across an arm of the sea, even though very narrow*.

Lastly, the great number of species of ferns constitutes the most interesting result of the inquiry. Amongst these eleven species of ferns there are only two, *Acrostichum aureum* and *Nephrolepis exaltata*, which are widely distributed over the islands of the hot regions. For these two species, which probably prefer a soil more or less impregnated with saline matters, Krakatao can offer some advantages in this respect; for the nine other species this is not the case.

But more than that. In order to judge of the relative importance of plants belonging to different groups in the restocking of a country, the point in question in the first place is not the number of species but the number of individuals. Looking at it from this point of view, I can formulate the result of the inquiry made at Krakatao thus:—

Three years after the eruption the new flora of Krakatao was composed almost entirely of Ferns. The Phanerogams were only found isolated, here and there on the shore or on the mountain itself.

It is therefore ferns to which the rôle reverts of preparing the earth for the phanerogamic vegetation, which in time will cover the island again as it covered it before the eruption.

There is nothing at all astonishing in the fact that numerous spores of ferns fall on Krakatao, since the wind carries even the seeds of phanerogams over the island; but what is almost incomprehensible to any one on the spot is how the ferns and their prothallia succeed in living under such disadvantageous conditions. Chemically and physically the volcanic matter which covers Krakatao constitutes one of the most arid of soils. To give an idea of the chemical composition presented to plants by this substratum, I reproduce the result of two analyses according to M. Verbeek †:—

| | No. 7 a. | No. 9 a. |
|--------------------------------------|----------|----------|
| Si O ₂ | 61·36 | 68·99 |
| Ti O ₂ | 1·12 | 0·82 |
| Al ₂ O ₃ | 17·77 | 16·07 |
| Fe ₂ O ₃ | 4·39 | 2·63 |
| Fe O | 1·71 | 1·10 |
| Mn O..... | 0·41 | 0·28 |
| Ca O | 3·43 | 3·16 |
| Mg O..... | 2·32 | 1·08 |
| K ₂ O | 2·51 | 1·83 |
| Na ₂ O | 4·98 | 4·04 |

* The distances of Krakatao from Sibesia, Sumatra, and Java are 10, 20, and 21 miles. The two small islands "Lang eiland" and "Verlaten eiland," which were completely laid waste at the time of the eruption, were absolutely uninhabited at the period of my visit to Krakatao.

† R. D. M. Verbeek, 'Krakatao,' Batavia, 1885-86, p. 309.

M. Verbeek adds: "the dark-coloured ash no. 7 *a* is probably the most basic, the pumice no. 9 *a* the most acid product of those cast out by Krakatao in 1883." It has been said of the island of Ascension that the soil resembles powdered glass. It is clear that the same thing might be said of Krakatao.

As for the physical conditions, the pumice-stone and the greyish-coloured ashes which cover Krakatao are continually heated by a scorching sun, without there being any trace of shade.

With the assistance of my friend Dr. Burck I made, in the laboratory of the garden at Buitenzorg, sowings of the fern-spores brought back from Krakatao on all kinds of substratum. We wished to see whether the prothallia and young plants of these ferns presented any special adaptations which would enable them to overcome conditions so little favourable as those offered by the soil of Krakatao. During an examination which was of necessity brief* nothing revealed the presence of special adaptations either in the prothallia or in the young plants.

To the mind of one verifying on the spot the predominance of ferns at Krakatao the following questions immediately present themselves. How can the fern-spores germinate under such conditions? are there not plants of a lower order there, which cover the pumice-stone and the ash with a thin layer, enabling the spores to germinate? In the first place I thought of small lichens; but I did not succeed in finding a single lichen on the whole island. But here and there on the surface of the ash and of the pumice a glaucous or greenish layer could be distinguished, which evidently arose from Algæ. A minute examination with the lens showed that the same thing existed nearly everywhere, though in a less pronounced degree. I then collected samples of the superficial layer of the soil of Krakatao from several places in order to examine them at Buitenzorg.

It appears that the ash and the pumice composing the soil of Krakatao are covered almost everywhere with a thin layer of Confervoid Algæ.

I have proved the presence on Krakatao of six species of these Confervoid Algæ, to wit: one *Tolypothrix*, one *Anabana*, one *Symploca*, and three species of *Lyngbya*. I shall distinguish provisionally the last three species by the following names:—

* In consequence of the indisposition which compelled me to return for some time to Europe.

Lyngbya Verbeekiana, thickness without sheaths from 1·9 to 3·4 μ , with sheaths from 5 to 6·8 μ .

Lyngbya minutissima, maximum thickness, without sheaths 1·03 μ , with sheaths 1·38 μ .

Lyngbya intermedia, thickness without sheaths from 1·73 to 3·45 μ , with sheaths from 1·73 to 3·45 μ^* .

By far the most common of these species is *Lyngbya Verbeekiana*; next comes *Lyngbya minutissima*. These two Algæ very frequently emerge from their sheaths.

Thanks to these six species of Algæ and to their empty sheaths, especially of the two *Lyngbyæ* I have just mentioned, the arid soil of Krakatao is covered with a thin gelatinous and hygroscopic layer. There is no doubt in my mind that the presence of this layer alone enables the spores of the ferns and of mosses to germinate. On one of the samples of the soil of Krakatao I found a spore of *Pteris longifolia* with a germinative filament of three cells imprisoned in a network of sheaths of *Lyngbya Verbeekiana*.

The Algæ prepare the earth for the Ferns in some such manner as the latter do in their turn for the Phanerogams.

Let us now suppose for an instant that Krakatao, instead of being only a score of miles from Java and from Sumatra, was isolated in the sea at a very great distance from all plant-bearing land. What would take place? The belt of phanerogams installed on the littoral of the island would climb the mountain up to a certain height, driving back the ferns. This progress would only be arrested at an altitude which no longer suited the elements of the littoral flora. Considering the isolation of the island, the seeds of other phanerogams, fitted for existence at greater altitudes, would never or hardly ever arrive at this station lost in the ocean. Consequently the ferns would retain their predominance for all time in the higher regions of the island, in company perhaps with some Lycopods, and the phanerogams would remain restricted to the lower regions and to the shore.

What we have just supposed for Krakatao is realized in the cases of Juan Fernandez and Ascension.

Juan Fernandez, a small volcanic island, is situated 400 miles from the coast of Chili. Mr. Moseley says of its flora:—"There are upwards of twenty-four species of ferns growing in this small island, and in any general view the ferns form a large proportion of the main mass of vegetation."

Ascension, an entirely volcanic island of about the same height as Krakatao, has a soil which has been described thus:—"St. Helena has been called a barren rock, but it is a

* So in the original.—Eds. 'Annals.'

paradise as compared with Ascension, which consists of a scorched mass of volcanic matter in part resembling bottle-glass and in part coke and cinders." In his 'Lecture on Insular Floras' Sir Joseph Hooker expresses himself in the following manner on the island and the vegetation which covers it:—"A small green peak, 2800 feet above the sea, monopolizes nearly all the vegetation, which consists of Purslane, a grass, and a *Euphorbia* in the lower parts of the island, whilst the green peak is clothed with a carpet of ferns, and here and there a shrub."

I have been led to add these data on Juan Fernandez and Ascension to show that the facts established for Krakatao do not constitute an exception.

I think, finally, that I am therefore justified in stating that :

During the advent of a new flora on a volcanic island which is under the same conditions as Krakatao, the Phanerogams will always be preceded by Ferns, and this doubtless owing to the less physiological differentiation of the latter.

After an island—or a portion of a continent—has been devastated by an eruption and covered with volcanic matter, the vascular Cryptogams—and especially the Ferns—still perform at the present day the same part which they very frequently did in the remote periods when they predominated on the earth's surface.

Voorschoten,
March 3, 1888.

XVII.—*Nototherium* and *Zygomaturus*.

By R. LYDEKKER, B.A., F.G.S.

IN a short paper recently published in the Proc. R. Soc. Queensland, vol. v. pp. 111–116, and plate, Mr. C. W. De Vis again raises the question whether the humerus referred by Sir R. Owen to *Nototherium* is rightly determined*.

This time, however, a new point of departure is taken. It may be observed in passing that Mr. De Vis starts the untenable proposition that the type of *Nototherium* being imperfect cannot be taken as the real type of the genus: but since this does not affect the question he has raised it need not be further mentioned. The gist of his contention is that the

* De Vis, Proc. Linn. Soc. N. S. Wales, vol. viii. p. 404. See also Lydekker, Cat. Foss. Mamm. Brit. Mus. pt. v. p. 161.

skull figured by Sir R. Owen in pls. xxxvi.—xxxviii. of his 'Extinct Mammals of Australia' as *Nototherium Mitchelli* does not belong to that genus at all. A cast of this skull, which I am informed by Mr. W. Davies has been somewhat restored, is preserved in the British Museum (no. 33259), and is entered on p. 162 of the 'Catalogue' already cited.

This skull is the one to which Mr. Macleay applied the name *Zygomaturus trilobus*. Now, so far as I know, the only original publication of that name was in a Sydney newspaper of 1857*, and since such publication cannot be regarded as one entitled to authenticate the name, I have not even quoted *Zygomaturus* as a synonym of *Nototherium* in the Museum 'Catalogue.'

Now Mr. De Vis states that in this skull the upper premolar is not of the triangular type which obtains in specimens which he regards as typical examples of *Nototherium*; and he figures an isolated upper tooth which he considers to correspond with the premolar in question, with the conclusion that both this specimen and the skull should be considered as indicating an animal generically distinct from *Nototherium*, for which he proposes to adopt the name *Zygomaturus*.

Unfortunately for this contention if the cast of the skull no. 33259 be carefully examined, it will be found that while on the right side the tooth in the position of the premolar is of the general type of the one figured by Mr. De Vis, on the left side the premolar is much smaller, this being clearly shown in the reversed figure given by Sir R. Owen in the Quart. Journ. Geol. Soc. vol. xv. pl. vii. fig. 1. The difference is so great that whereas on the right the so-called premolar is as long as the first molar, on the left side the premolar is much shorter than the molar and is of the triangular type which Mr. De Vis regards (and rightly) as typical of *Nototherium*.

This, therefore, at once disposes of the contention that no. 33259 cannot be referred to *Nototherium*. Other evidence is, moreover, afforded by the associated specimens nos. 43087, 43087 *a* in the British Museum ('Catalogue,' pp. 162–163). Thus the former exhibits the base of a triangular premolar of the moderately large size of the corresponding tooth of the left side of 33259, while the latter shows the peculiar form of the zygomatic arches and nasals characteristic of that skull. No. 43087 is most undoubtedly a typical *Nototherium*, and was referred by Sir R. Owen to his *N. inerme*; and the characters of the associated nasals and zygomata decisively refute the statement of

* See Owen, Quart. Journ. Geol. Soc. vol. xv. p. 168 (1858).

Mr. De Vis (*l. c.* p. 115) that the *Nototherium* skull was of the Diprotodont type and unlike no. 33259.

Again, Mr. De Vis states (p. 116) that the mandible of the so-called *Zygomaturus* is unknown; but no. 33259 has with it the cast of a mandible which appears to have been taken from a specimen associated with the cranium. This mandible, although not showing the premolar, is that of a typical *Nototherium*.

Sufficient has now been said to show that Mr. De Vis has not a leg to stand upon in the new view propounded; and since he suggests that the humerus in question may have belonged to his so-called *Zygomaturus*, the original reference of that bone to *Nototherium* remains, at least for the present, undisturbed.

There is, however, still the question as to what the tooth on the right side of no. 33259 really is. Now it appears to me that this tooth is either an abnormality, or that it is not homologous with the tooth on the left side, or that it has been inserted in a skull to which it does not belong*. The last suggestion appears to me to be the most probable one, although it would leave unexplained to what animal this tooth and the somewhat similar one figured by Mr. De Vis really belong. It is clear that the skull in question is adult, so that this tooth cannot be pm.^3 if it belong to that skull, while its dissimilarity from the true molars forbids the view that it can be mm.^4 .

On the other hand, there is a certain similarity between this tooth and some specimens of pm.^4 of *Diprotodon*, although it is larger than any specimens of that tooth which I have seen. Assuming that this type of tooth is not an abnormal last premolar of *Nototherium*, it may be suggested that it may possibly be the deciduous pm.^3 of *Diprotodon*. So far as we know at present there is no evidence of any tooth-change or of the presence of a deciduous pm.^3 in either *Diprotodon* or *Nototherium*; but the loss of such change being evidently an acquired character, we might reasonably expect to meet with reversionary instances in which such a change took place. The rarity of this type of tooth, to which Mr. De Vis alludes, so far as it goes, is in favour of this suggestion.

I can of course say nothing as to what may be the nature of the crushed *Diprotodon*-like skulls which Mr. De Vis would

* In writing the 'Catalogue' my attention was not especially directed to this discrepancy in the two teeth. I may take this opportunity of stating that no. 47840 (Cat. p. 168), which was labelled by Sir R. Owen *Nototherium Mitchelli*, and so catalogued, really belongs to *Diprotodon*.

refer to *Nototherium* beyond suggesting that they may indicate young individuals or a small species of *Diprotodon* itself.

I may add that in the 'Catalogue' I provisionally followed Prof. Flower in not regarding *Nototherium inerme* as distinct from *N. Mitchelli*; and the foregoing considerations regarding the abnormal tooth of no. 33259 are somewhat in favour of that view. Still there is a possibility that *N. inerme* may indicate a distinct species, and in that case the premolars figured by Mr. De Vis in the plate accompanying his paper as types of his *N. dunense* will be certainly referable to the former species. The figured upper premolar is indeed almost identical with a cast of a tooth of the opposite side in the British Museum (no. M. 3643, Cat. p. 164).

Lastly, the generic name *Owenia*, proposed by Mr. De Vis for a small form apparently closely allied to *Nototherium*, is preoccupied at least three times over, the earliest application of the name dating from 1847.

BIBLIOGRAPHICAL NOTICE.

Bergens Museums Aarsberetning for 1887. 8vo. Bergen, 1888.

THE Annual Report of the Museum at Bergen for 1887 certainly does not yield to its predecessors in interest. The first article, written in English by Prof. D. C. Danielssen, is particularly important; it relates to the "Actinida of the Norwegian North-Atlantic Expedition," and reveals the existence of what seems to be a perfectly novel series of characters in certain forms which would be taken to belong to the *Peachia* and *Ilyanthus* type of Sea-Anemones. The most remarkable point in the structure of these creatures consists in the presence of a complete intestinal canal, running directly from the mouth to the posterior extremity, where it opens outwards through a regular anal pore. Of course the presence of a pore at this point in certain genera of Sea-Anemones is a well-known fact, but in none of these is there a regularly formed intestine, and the peculiarity of the type is further increased by the complete division of the body-cavity into longitudinal chambers by septa joined throughout to the intestine. One can quite sympathize with Dr. Danielssen in the "dubiety" which he entertains as to the "systematic position of these remarkable animals," which are not Cœlenterates, although they certainly "belong to the great animal-group of Radiata." Dr. Danielssen recognizes two genera, which he somewhat fancifully names *Ægir*, after the Scandinavian Neptune, and *Fenja*, after a sorceress supposed to reside at the bottom of the sea and to occupy herself in grinding salt! The

structure of the animals, which were obtained by deep dredging at four different stations, is described at some length by Dr. Danielssen, and pretty fully illustrated on three quarto plates.

The two new Cornulariæ from the Norwegian coast described by Mr. James A. Grieg in the second article can make no claim to the somewhat romantic interest attaching to Dr. Danielssen's Actinida, although they also form part of the spoils of the North-Atlantic Expedition. They are unmistakable Alcyonarians belonging to known genera, namely *Rhizoxenia alba* and *Sympodium margaritaceum*, and they are carefully described and well figured. Short characters and an explanation of the two plates are given in English.

Mr. Grieg also publishes the first of a projected series of articles on the fauna of the Westland fjords, in which he deals with the animal life of the Mostertfjord, and gives lists of the Mollusca, Tunicata, and Coelenterata which have been ascertained to inhabit that locality. He indicates the rarity or abundance of the different species and has remarks upon their mode of occurrence. The Porifera are noticed as Coelenterata.

The last article in the volume, written, like the first, in English, shares with it in zoological interest, and bears the following title:—“A Protandric Hermaphrodite (*Myxine glutinosa*, L.) amongst the Vertebrates.” The author, Dr. Fridtjof Nansen, Curator of the Bergen Museum, describes the circumstances which led him to the conclusion that the hagfish is a protandric hermaphrodite, and goes in some detail into a discussion of the phenomena of reproduction in the *Myxine*. His conclusions are summarized as follows:—

“1. *Myxine glutinosa* is a protandric hermaphrodite. Up to a body-length of about 32 or 33 centimetres it is a male, after that time it produces ova.

“2. The proportion between the posterior male portion of the reproductive organ and the anterior female portion is not constant; the male portion is generally, however, about one third of the whole length of the organ.

“3. The few “true” males of *Myxine* observed are probably transformed hermaphrodites.

“4. The young testicular follicles or capsules have a structure quite similar to that of the young ovarian follicles. They contain a large sexual cell, spermatogon, which is enveloped by an epithelium, follicular epithelium, and a connective-tissue envelope.

“5. The spermatogon is, by subdivision, converted into spermatides, which are separated from each other and swim in a fluid inside the testicular capsules. By gradual elongation of the nucleus, as well as the whole cell, the spermatides are converted into ripe spermatozoa, which pass into the body-cavity when the testicular capsules burst.

“6. Nearly ripe spermatozoa may be found in specimens of *Myxine* at every season of the year.

“7. *Myxine* deposits its ova at every season of the year.”

Two other natural-history articles are of botanical interest, dealing with the diseases of certain important plants. Both are from the pen of Dr. J. Brunchorst. The first (in Norwegian) is a revision of the plant-diseases of economic importance which occur in Norway, and gives the results of a special journey undertaken by the author for the purpose of investigating the diseases which affect the principal cultivated plants, and contains his observations upon barley, rye and oats, potatoes, clover, turnips, and kale, also upon natural pine-woods, fruit-trees, hops, and roses. In the majority of cases the mischief is done by fungi, which is also the case with the disease of the black-fir (*Pinus austriaca*), which forms the subject of Dr. Brunchorst's second memoir (in German). This disease, which attacks the needles and twigs of the trees, seems to have been very injurious; but the fungus which causes it cannot be identified further than that it is the pycnidian stage of an Ascomycetan. It also attacks the dwarf pine (*Pinus montana*), which has been planted over a great extent of the west coast of Norway. This paper is illustrated with two plates.

The only other article in this Report is an account by M. A. Lorange of the discovery in a mound near the Karmsund of a portion of a vessel of the age of the Vikings; but the antiquary will also find some interesting objects figured upon two plates representing specimens presented to the Museum during the year.

MISCELLANEOUS.

On a new Parasite of Amphiura. By J. WALTER FEWKES.

THE Secretary read a communication on the parasitism of a Crustacean in the brood-cavities of a common brittle-star (*Amphiura squamata*), which he had discovered while at work in the Marine Laboratory at Newport.

The Ophiurans, or brittle-stars, have two methods of development or metamorphosis, known as the direct and indirect. In the indirect the young passes through a stage called the pluteus, in which a provisional organism is developed from which the young form by budding, the provisional organism or pluteus being eventually absorbed by the growing young of the brittle-star. Our common *Ophiopholis* (*O. aculeata*) has such a pluteus. In the case of other Ophiurans, such as *Amphiura*, however, there is no free pluteus in their metamorphosis, but the young are developed, without nomadic stages, in special sacs of the mother, called brood-sacs, of which there are ten situated in pairs on each side of the [bases of the] arms. The young *Amphiura* passes its early life in these sacs, at first attached by an umbilicus, afterwards free, and remains there until it

has reached a considerable size. Morphologically both forms of metamorphosis are identical; but while certain structures, as, for instance, parts of the calcareous framework of the pluteus, are recognizable, a nomadic pluteus is never formed in this genus.

In collecting adult *Amphiurans* in order to discover new stages in the development of the young my attention was often attracted to certain adults of this genus in which a portion of the upper (aboral) surface of the body has a reddish colour, while in most specimens the body is chocolate-brown. This coloration was noticed to be ordinarily limited to a marginal region of the body just between the radial shields.

It was invariably found, when those adult *Amphiuræ* with reddish coloration on the aboral surface of the body were dissected, that young were absent from the brood-sacs. It was, moreover, almost invariably found that in these adults the ovary had suffered a change and had degenerated into an amorphous mass in which ova were not recognizable. In the brood-sacs of such, instead of young *Amphiura* there were found small packets of pink-coloured ova, which, when seen through the wall of the body, impart the reddish colour to the aboral body-wall. In addition to these packets of ova it was likewise found that the brood-cavities of many of the specimens thus abnormally coloured harboured a small Crustacean. In an examination of the pinkish clusters of ova in the brood-sac of the *Amphiura* it was discovered that they are in all conditions of growth from the first stages of segmentation into a well-formed Nauplius. Young Crustaceans free from the packet of ova were also found in great numbers in the brood-sacs. These adults were identified as belonging to the group of Crustacea called the Copepoda.

An interpretation of the above facts seems to be that we have here a strange instance of parasitism. It is also thought to be unique among the Echinoderms. Although many genera of parasitic Copepods are known, I am not familiar with recorded instances where these parasitic Crustaceans enter the brood-sac of an *Amphiura* and destroy the virility of its host for the good of its own offspring. Many instances of Crustacean parasites castrating other Crustaceans have been recorded by Giard; but in these cases it has not been shown that the castration of the host is a direct benefit to the offspring of the parasite itself. In *Amphiura*, however, we have a condition where we can legitimately conclude that the amorphous condition of the ovary of the *Amphiura* is the direct result of the presence of the mother Crustacean in the brood-cavity of the *Amphiura*. We may suppose that the parent of the Crustacean made her way through the genital slits of the Echinoderm into the brood-sacs, and there spayed the *Amphiura*. Packets of the ova were left in the brood-sacs to develop. With the destruction of the possibility of offspring in *Amphiura* within her own brood-sacs the future life of the young Crustacea was assured, and

we may readily see, if the precaution of preventing the development of young *Amphiura* had not been taken, the young Crustaceans might have fallen easy prey to the vigorously growing young of the brittle-star.

Many questions of theoretical interest suggest themselves in regard to the curious condition of parasitism mentioned above. How by a theory of the advantage which has come to the Crustacean has the life within the brood-sac of *Amphiura* originated? That it is a manifest protection to the young Crustacean to be sheltered by its host appears self-evident, and one can on this ground find abundant cause for the mode of life which has been mentioned. Moreover, it is also a great advantage that the young of the *Amphiura* be destroyed. We may then suppose that in the evolution of this manner of life, after the Crustacean has found a home in the brood-sac of the brittle-star, the ovaries of the *Amphiura* may have been aborted by the parasite, and this habit of destroying the ovary has led to a survival of the young Crustacean. That habit becoming hereditary has led to the condition of life as it now exists. Whether the ovaries were first used as food, and in that way the habit of spaying the *Amphiura* arose, I cannot say. It is possible that they offered a tempting morsel to the Crustacean, and the advantage thus gained by the parasite over others has led through heredity to the condition which we at present find.—*Proc. Bost. Soc. Nat. Hist.* vol. xxiv, p. 31.

The Bressa Prize.

The Royal Academy of Sciences of Turin gives notice that from the 1st of January, 1887, the new term for competition for the seventh Bressa Prize has begun, to which, according to the testator's will, scientific men and inventors of all nations will be admitted. A prize will therefore be given to the scientific author or inventor, whatever be his nationality, who during the years 1887-90, "according to the judgment of the Royal Academy of Sciences of Turin, shall have made the most important and useful discovery, or published the most valuable work on physical and experimental science, natural history, mathematics, chemistry, physiology, and pathology, as well as geology, history, geography, and statistics."

The term will be closed at the end of December 1890.

The value of the prize amounts to 12,000 Italian lire.

The prize will in no case be given to any of the National Members of the Academy of Turin, resident or non-resident.

The President of the R. Academy,
A. GENOCCHI.

Turin, January 1st, 1889.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 15. MARCH 1889.

XVIII.—*Contributions to the Anatomy of the Central Nervous System in Ceratodus Forsteri.* By ALFRED SANDERS, M.R.C.S., F.L.S.

[Plates VIII.—XIII.]

CERATODUS has been known for so short a time that the literature of its nervous system is by no means extensive; three memoirs exhaust the list of those that refer to that subject—one by Prof. Huxley *, another by Beauregard †, and a third by Prof. Burt. G. Wilder ‡, to which may be added two others which touch only slightly or not at all on the nervous system; these are a very full account of the anatomy of *Ceratodus* by Dr. Günther §, a memoir which first introduced the animal to the notice of scientific men, and another, more recent, by H. Ayers ||, which goes more into the microscopic anatomy.

* “Contributions to Morphology. Ichthyopsida.—No. 1. On *Ceratodus Forsteri*,” Proc. Zool. Soc. 1876.

† “Encéphale et Nerfs Craniens du *Ceratodus Forsteri*,” Journ. de l’Anatomie et Phys., Ch. Robin and G. Pouchet, 1881.

‡ “The Dipnoan Brain, *Ceratodus*,” American Naturalist, vol. xxi. 1887.

§ Phil. Trans. Roy. Soc. 1871.

|| “Beiträge z. Anatomie und Physiologie d. Dipnoer,” Jenaische Zeitschrift f. Naturwissenschaft, Bd. xviii.

Ann. & Mag. N. Hist. Ser. 6. Vol. iii.

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There are a few memoirs which treat of the brain of *Protopterus* or *Lepidosiren* which will be referred to in the course of this paper.

The specimens on which the present paper is founded were caught under my immediate supervision in the River Burnett at Gayndah, in Queensland, Australia.

The treatment to which the nervous system was subjected was applied before molecular death could take place.

This treatment consists in placing the head immediately after it has been cut off into Müller's solution to which spirits of wine has been added in the proportion of one third; the solution is changed next day and again two or three times in the course of three weeks: the skull containing the brain is then placed in a 2-per-cent. solution of potassium bichromate, which is changed about once a fortnight, until the brain becomes sufficiently hard to be sectioned; this occurs at various periods, taking a shorter time in the higher Vertebrates than in the lower; in the present case the period extended to more than twelve months.

The best staining-fluid, I find, is an aqueous solution of the aniline dye known commercially as soluble blue.

This method may seem antiquated to some people, who think everything new must be best; but I have always found it to succeed well, and it is of great advantage to persons situated as I was, who are not in a position to attend to cutting sections for some time after the capture of the animals; in fact I can recommend it as an all-round method for travellers, and in cases where the material is too precious to be wasted on experiments it is better than most of the new ones, which although perhaps for minute points they may be good, yet are more or less uncertain, and are therefore not suited for use in the bush.

The chromo-silver method of Golgi, for instance, as given in Fridtjof Nansen's memoir *, is excellent for showing cell-processes of the brain in the higher Vertebrates, but requires more civilized surroundings than are to be found in that sort of place for its proper carrying out.

MACROSCOPIC ANATOMY.

General Description.

The brain (Pl. VIII. fig. 2) on its ventral side accurately fits into a depression in the base of the skull; but on the

* 'The Structure and Combination of the Histological Elements of the Central Nervous System:' Bergens Museum, 1886.

dorsal side the cranial cavity is much larger, so that there is a considerable space between the walls of the cranium and the surface of the cerebro-spinal centres; this is filled by a coarse and loose network of connective tissue, the trabeculae of which carry vessels and capillaries; this arrangement resembles that of *Protopterus*, and, as Wiedersheim* remarks, may possibly serve to secrete the subarachnoid fluid.

A thick membrane of great toughness encloses the brain and spinal cord; but towards the posterior end of the latter it becomes thinner and more membranous.

Two glandular bodies are developed in connexion with this pia mater, as it may be called, it evidently corresponding to that structure, at least in position. The posterior body, of a spongy character, forms a cover to the sinus rhomboidalis, or fourth ventricle, resembling that of *Petromyzon* as described by Ahlborn†. It closes the whole ventricle with the exception of a small opening at the posterior end, in this respect resembling the corresponding structure in Plagiostomata; its structure is not so much vascular as of a glandular nature, being composed of a congeries of tubules which appear to connect an upper and lower plate; externally the whole is connected with and passes into the tough pia mater enveloping the medulla oblongata, which is continuous with the membrane that encloses the remainder of the brain.

The anterior body, which Beauregard‡ mistook for nervous tissue, resembles the cover of the fourth ventricle in structure, inasmuch as its tissue is made up of tubules, but differs in the fact that these tubules are more contorted; it enters the third ventricle, forming a spongy mass, termed by Prof. Huxley§ the tela vasculosa, but in which I failed to discover any capillaries, its structure being entirely glandular.

This spongy mass (Pl. IX. fig. 5) extends to the anterior end of the cerebrum, separating the dorsal wall of one side from that of the other, so that the lateral ventricles are not closed in above by nervous tissue. At the anterior end of the cerebrum the lower surface of this structure is connected by a lamina of connective tissue which passes between the inferior internal fold of the cerebrum to join the general covering of pia mater at the inferior surface of the brain. This fold is

* 'Morphologische Studien:' Jena, 1880, p. 73. Also *Jenaische Zeitschr.* Bd. xiv. (1880).

† *Zeitschr. f. wiss. Zool.* Bd. xxxix. (1883).

‡ *L. c.* p. 232.

§ *L. c.* p. 29.

termed the "Falx" by Prof. Burt. G. Wilder *, who was not certain that it was continuous with the lower surface of the tela choroidea. The ventricular partition is thus seen to be made up for a great part of its extent by tissue which is not nervous. The function of these two bodies is probably, as Wiedersheim † suggests in *Protopterus*, also in this case, for the purpose of secreting the cerebro-spinal fluid.

Over the third ventricle the pia mater forms a sort of conical membranous cap, in the summit of which is found a body, the pineal gland; but this shows no retinal structure, even in the modified form described by Ahlborn in *Petromyzon*, much less the comparatively high development described by Spencer ‡ in *Lacertilia* and by Graaf § in *Anguis fragilis*. This cover resembles that in *Protopterus* ||, but it extends much higher in *Ceratodus*; in *Lepidosteus* also a membrane resembling this is described by Balfour and Parker ¶, but this latter appears to resemble more *Protopterus* than *Ceratodus* in appearance. In *Rhina squatina* and *Acanthias vulgaris* also there is a membranous cover to the thalamencephalon, which seems to be a homologous structure.

The pia mater is more closely attached to the rhinencephalon than to the remainder of the brain, where it can be easily stripped off with a pair of forceps. On the ventral surface (Pl. XI. fig. 15) of the medulla oblongata and the commencing spinal cord, immediately in front of the entrance of the anterior root of the trifacial nerve, the anterior median fissure is filled up with a development of the pia mater of a semicartilaginous consistence; it is not, however, by any means of the structure of cartilage, but consists of thick, round, smooth fibres, several of which join together into one at the external edge in a transverse direction, forming a sort of fenestrated structure, whereby it becomes thicker in the central line and thins off exteriorly, where it joins the ordinary membrane; it appears to act as an elastic pad which would protect the medulla oblongata from sudden shock; but why the other parts of the brain should not be as well protected does not appear.

Like *Protopterus*, *Ceratodus* presents a wide and well-developed medulla oblongata connected by a narrow mesencephalon and thalamencephalon with the prosencephalon; but there is no sudden angle between the former and the latter as is described by Wiedersheim ** in *Protopterus*.

* *L. c.* p. 546.

† *L. c.* p. 71.

‡ Quart. Journ. Micr. Sci. 1886.

§ Zool. Anzeiger, March 1886.

|| Wiedersheim, *l. c.* p. 71, fig. 21.

¶ Phil. Trans. 1882.

** *L. c.* p. 70.

When the pia mater is stripped from the prosencephalon, the nervous tissue that remains is not of any great amount; it forms a pair of thin plates, each folded so as to form the outer walls and the lower part of the inner walls of two imperfect lateral ventricles, which, as above said, are completed by the tela choroidea. I look upon them as lateral ventricles, notwithstanding that their walls are not completed by nervous tissue; but if it is considered essential to the connotation that the nervous walls should be complete, then of course the term *ventriculus communis* should be applied. The chamber thus formed is elongated from before backward, but is narrow from side to side in its dorsal part; anteriorly it communicates with the ventricle of the olfactory lobe by a foramen passing through the neck of the same. Beauregard* supposed that the anterior part of the prosencephalon belonged to the rhinencephalon; but microscopic examination shows that it has the same structure as that of the remainder of the cerebrum.

Below, this chamber communicates with an expanded bulla by a large oval opening extending for the whole length of the cerebrum; the inner wall of this bulla is in contact with that of the other side, but separated by a layer of pia mater, and is only attached behind by a very small transverse commissure.

The prosencephalon in *Ceratodus* differs from that of *Protopterus* in the incompleteness of the nervous tissue of the walls†, but agrees in the hemispheres being entirely separable except for the above-mentioned narrow transverse commissure, which in *Protopterus* runs between the two crura cerebri, but in *Ceratodus* between the posterior ends of the cerebrum itself. The latter also differs in the greater development of the rhinencephalon, which in Wiedersheim's figures is not shown, but which Fulliquet‡ by transverse sections demonstrated to be present indeed, but small and scarcely separable from the cerebrum.

The thalamencephalon is a deep trough, open above, where pia mater alone closes it. It is wider in front, where it communicates with the lateral ventricles by a broad opening, which is divided into two by the tela choroidea, narrower behind, where it passes into the aqueduct of Sylvius by a foramen nearly as large as the ventricle of the optic lobe; above this latter opening is situated the posterior commissure, which is not visible by the naked eye, but is shown in the microscop-

* *L. c.* p. 231.

† Wiedersheim, *l. c.* p. 70.

‡ "Recherches sur le cerveau du *Protopterus annectens*," *Recueil Zoologique Suisse*, tome iii, (1886).

pical sections ; on the posterior end of the walls, immediately in front of the point where they merge into the optic lobe, there is a tuberosity which transverse sections demonstrate to be double (Pl. IX. fig. 5) ; these tuberosities form the ganglion habenulæ, which corresponds to the tuberculum intermedium of Teleostei and Plagiostomata.

Fulliquet in his detailed description of the brain of *Protopterus annectens* mentions two tuberosities in a corresponding position which much resemble these. He considers that they form part of the epiphysis. This surely must be a misapprehension ; they might be, and probably are, remains of the ganglion which supplied that sense-organ, but they could not be part of that sense-organ itself.

On the floor of the thalamencephalon there is visible anteriorly the projecting cord of the commissure of the two hemispheres, which corresponds to the anterior commissure ; behind this is an opening leading into the infundibulum.

The pituitary body or hypophysis is a large and extensive structure formed apparently of glandular tissue composed of interlacing tubules ; it seems to be much larger here than in *Protopterus*.

No part of the chiasma nervorum opticorum is visible externally, but on removal of the pia mater the optic tract is distinctly seen passing upward and backward to the summit of the optic lobe ; this is much more visible in brains preserved in potassium bichromate than in spirit preparations.

The mesencephalon is a paired tuberosity, small and narrow, and does not present that external transverse striation, visible presumably to the naked eye, given in fig. 20, taf. iii. of Wiedersheim's paper. Fulliquet* lays great stress on the fact that in *Protopterus annectens* the mesencephalon is single ; he considers that this indicates a low degree of development, the original single state of this segment of the encephalon being preserved.

Although the cerebellum is not well developed, being merely a bridge crossing the anterior end of the sinus rhomboidalis, yet it appears to exceed that of *Protopterus* in size ; internally it presents a longitudinal ridge, which dwindles away posteriorly ; externally the position of this ridge is indicated by a median longitudinal furrow ; posteriorly it terminates in a free edge.

The sinus rhomboidalis is a broad shallow trough which diminishes posteriorly rather suddenly ; its widest part is just behind the crura cerebelli. The floor is flat, and in the central

* L. c. p. 20.

line two longitudinal ridges, separated from each other by a median longitudinal furrow, are faintly visible; at the anterior end two other longitudinal ridges appear, which contain the ganglion of origin of the anterior root of the trifacial. These two pairs of ridges pass beneath the cerebellum, and the central ones are traceable into the aqueduct of Sylvius. Posteriorly this ventricle passes by a long funnel-shaped passage into the central canal of the corda spinalis.

Apparent Origin of the Cranial Nerves.

Second pair (Pl. VIII. fig. 1, n. 2).—The optic nerves, which are of small size, pass after a long course each through a foramen which appears to correspond to the optic foramen. Each one is closely attached for a short distance to the first branch of the trifacial nerve; but it is possible to separate them by dissection without injury to either. The nerve, then passing between the origins of the eye-muscles, enters the eyeball.

Third pair (Pl. VIII. fig. 1, n. 3).—The oculomotor arises in the usual position at the base of the optic lobe in what Ahlborn terms the epichordal part of the brain, and passing out of the brain through its special foramen, it immediately enters the sheath of the first branch of the trifacial, from which it cannot be dissected without injury; after a short distance it abandons its companion, and, taking an independent course, can be traced to the muscles of the eyeball. In *Protopterus* Wiedersheim was uncertain about the origin of the corresponding nerve, thinking it might be a branch of the trifacial. Fulliquet*, however, found its origin in the usual position, but supposed that the first branch of the trifacial shared its distribution; if this should be the case in *Protopterus* it certainly is not so in *Ceratodus*, although of course in the latter case there may be an interchange of fibres. Serres† absolutely denies the existence of this nerve in *Protopterus*, as also of the fourth and sixth.

Fourth pair.—The trochleares are too small to be seen in a macroscopic dissection, which justifies Serres in denying their existence; but when we come to the microscopic description it will be seen that their presence is demonstrable in the transverse section of the part between the optic lobes and the cerebellum, where their decussation and emergence from the brain are distinctly to be seen (Pl. XI. fig. 9).

Fifth pair.—Trifacial arises by two roots immediately behind the junction between the cerebellum and the restiform

* *L. c.* p. 30.

† *Compt. Rend.* 1863, p. 579.

bodies ; the anterior is the largest ; on it the gasserian ganglion is developed, after passing through which it joins the posterior root, which arises a short distance behind the anterior root, and immediately divides into two branches, which join the anterior root just beyond the ganglion.

The branches of the trifacial in *Ceratodus* do not exactly correspond to those of this nerve in Mammalia, but seem to be more generalized, and the distribution of the various trunks appears to be interchanged to some extent.

The first branch, which may be looked upon as the ophthalmic, is given off from the anterior root before its junction with the two branches of the posterior root. It passes out of the skull through a special foramen into a fossa, which is occupied by the temporal muscle and which is not divided from the orbit ; it passes forward closely applied to the outside of the skull, where it is joined by the oculomotor nerve, as already mentioned ; it then passes round a process of the bone named by Prof. Huxley the pterygo-palatine to the outer side of the olfactory lobe ; it then crosses the olfactory sac, immediately in front of its connexion with the olfactory lobe, to the outer edge of the cartilage dividing the two olfactory sacs and lobes from each other, which is termed by the same authority the mesethmoid cartilage ; it then passes forward between the olfactory sac and this cartilage, and finally dividing into two branches, is distributed to the external skin of the central portion of the upper lip.

The posterior root (Pl. VIII. fig. 1, *co.*) gives off close to the junction of its two branches with the anterior root a communicating branch to the vagus ; this curves round through the outer wall of the ear-capsule, external to the semicircular canals, and joins the vagus just beyond where the branchial nerves and the visceral branch are given off, so that it only joins the ramus lateralis ; it thus differs from the *Lepidosiren paradoxa*, in which, according to Hyrtl *, the communicating branch joins the ganglion of the vagus, whereas here it effects a junction beyond it.

The junction between the anterior and posterior roots of the trifacial takes place in a slightly different manner on the two sides ; on the right side the whole of both roots join at once, on the left side there is a supplementary junction in the shape of a short branch from the posterior root which joins the anterior root at some distance along its course.

The nerve (Pl. VIII. fig. 1, *m.*) resulting from this junction may be looked upon as the combined superior and inferior maxillary ; it divides into two branches, an external and an

* Abhandl. d. königl. böhmisch. Gesellsch. d. Wiss. Bd. iii. (1843-4).

internal branch; at the anterior border of the temporalis muscle both these give off twigs to the floor of the orbit; the external branch then goes forward over the membranous bag which is situated above the side of the mouth. This bag has no communication with the olfactory vestibule, on the outside of which it is placed, but opens externally behind the angle of the mouth through a special aperture. The nerve ultimately divides into two branches, each of which gives off terminal filaments in a fan-like manner, which are distributed to the deep side of the upper lip, external to the termination of the ophthalmic branch.

The internal division takes a turn inward and divides into two branches; the first goes directly downward and enters the upper border of the mandible, in front of the origin of the temporalis muscle; the second, which may be looked upon as the palatine nerve, passing beneath the ophthalmic, plunges downward immediately in front of the pterygo-palatine bone, and is distributed to the pad of mucous membrane situated on the roof of the mouth.

Sixth pair.—The abducens was not found in any of these specimens.

Seventh pair (Pl. VIII. fig. 1, n. 7.).—The facial arises immediately ventrad of the origin of the posterior root of the trifacial; it has a single root, which does not join either the fifth in front or the acusticus behind, as is the case in *Protopterus**, in which also, according to Fulliquet, it has two roots, but passes directly outward through the mass of cartilage on the outer side of the ear-capsule, which is probably the petrosal; it terminates by being distributed to the integument outside and in front of the branchial chamber; close to its origin it gives off from its under surface a branch which plunges down in the cartilage at the base of the skull and divides into a pair of trunks—one, passing forward through the base of the skull beneath the brain, eventually supplies the anterior part of the roof of the mouth, inside and between the olfactory sacs; the other passes back and supplies the middle and outer part of the anterior wall of the branchial chamber.

Eighth pair (Pl. VIII. fig. 1, n. 8.).—The acusticus arises by one root behind and beneath the trifacial, in close contact with the origin of the facial; its root emerges obliquely. At its origin the anterior margin is slightly higher on the left side and slightly lower on the right than that of the facial; but its posterior margin is on the same level on both sides. There is no accessory acusticus to be found here as is the case in *Protopterus*. This nerve divides into two main trunks,

* Wiedersheim, *l. c.* p. 75, fig. 19.

which are distributed on the inferior surface of the otic vesicle, one branch going to the external, the other to the internal division of that vesicle.

Ninth pair.—The glossopharyngeal has not a distinct and independent root in *Ceratodus*, but is a branch of the vagus, and will be described with that nerve.

Tenth pair (Pl. VIII. fig. 1, n. 10).—The vagus arises by five contiguous roots on the right side and by four on the left; the outer and anterior root is the largest in both cases.

The first branch is given off at right angles to the course of the nerve and is the glossopharyngeal; after a short course this branch enlarges into a ganglion, the distal end of which is the broader; from this ganglion three branches are given off. The most anterior, which is the largest, plunges down in front of the branchial chamber and supplies the membrane lining the anterior wall of that chamber; the middle branch is supplied to the membrane between the first branchial arch and the anterior wall of the branchial chamber; the third branch runs along the first branchial arch between the two lamellæ of the branchiæ to the ventral surface, where its terminating branches are distributed to the pharynx.

A short distance behind the glossopharyngeal a large ganglion is attached to the inferior surface of the main trunk of the vagus (Pl. VIII. fig. 1, gn. v.); this ganglion ends in three expansions, having first given off a small communicating nerve to the glossopharyngeal; the three terminating ganglia supply branches to the membrane closing the spaces between the branchial arches, and each gives off a nerve (Pl. VIII. fig. 1, b.) which runs in a groove at the base of the branchiæ to the ventral side, where it terminates in the same way as the branchial branches of the glossopharyngeal. In addition, the third swelling gives off a large nerve, which passes on behind the branchial chamber and becomes the visceral branch of the vagus.

The main continuation of the nerve, after giving off the above-mentioned ganglion, passes backward along the side of the vertebral column as the ramus lateralis (Pl. VIII. fig. 1, r. l.).

The origin of the vagus, as thus described, differs considerably from that of the corresponding nerve of *Protopterus**, in which it arises by both dorsal and ventral roots, which all end in the ganglion, the consequence being that none of the branches are independent of that body.

Two nerves arise from the ventral side of the posterior end of the fourth ventricle behind the vagus; they originate like

* Wiedersheim, l. c.

the ventral roots of the spinal nerves, except that they have two contiguous roots instead of one, which shows that each one ought to be counted as two. They have no dorsal roots, and take a long course in the vertebral canal before passing out through their respective foramina, which are high up in the vertebral arches on the same level as the foramina through which the dorsal roots of the succeeding spinal nerves emerge.

It is possible that they may correspond to the two ventral roots of the vagus, as described by Wiedersheim*, but here they certainly do not join the vagus. They cannot be looked upon as the hypoglossal, as the course usually followed by that nerve in fishes is here pursued by the second and third spinal nerves; their course outside the skull was not made out, but it is improbable that they would join those nerves, as the intervening trunk, which is the first spinal nerve, does not do so.

The ganglion (Pl. VIII. fig. 1, *sp. gn.*) of the spinal nerves forms an angle in the cartilage of the vertebral arch, and extending down near the outer edge to the level of the floor of the vertebral canal, it is there joined by the ventral root, which has itself passed through a distinct foramen.

The hypoglossal appears to be represented by the second and third spinal nerves, which pass into and supply the anterior fin.

Central Cavities.

The central canal (Pl. XI. fig. 15, *c. ca.*) in the spinal cord is rather large comparatively speaking; its long diameter is placed from side to side and it is compressed from above downward. In its progress forward the canal gradually widens, the lateral ends become pointed by degrees, and on approaching the posterior end of the fourth ventricle the sharp angle formed by these pointed extremities slightly turns downward. At this point the canal is a large and extensive channel occupying about one third of the extent of the section; the floor is convex and the roof is vaulted. A short distance in front of this region a depression or notch appears in the roof, which is attached to the dorsal edge of the section by a plug of connective tissue separating one side from the other; this depression increases as the canal deepens, until finally the fourth ventricle or sinus rhomboidalis opens out; the walls recede, the floor becomes wider, and the section enlarges in every direction—an enlargement due partly to the

* *L. c.* p. 76, fig. 19.

increase of the parenchyma, but principally to the expansion of the lumen.

The posterior part of the floor of the fourth ventricle presents the same form as that of the anterior part of the funnel-shaped termination of the central canal, except that at the lateral part the junction of the floor with the walls is more rounded and less sharp than further back.

The two multiaxial fibres, a description of which will be given presently, form a couple of ridges projecting into the floor; between the two there is a depression, and again on each side another leading to the lateral parietes, which are here perpendicular. Further forward the two prominences become higher and more marked, and contain not only the multiaxial fibres but also some of the fibres of the ventral columns; they correspond to the longitudinal ridges which are seen on the floor of the sinus rhomboidalis in the *Plagiostomata*.

In the wall of the ventricle there now appear two tuberosities, one forming a club-shaped dorsal termination, like a coping to a wall, which belongs to the trifacial (Pl. X. fig. 13, *v. tri.*), the other situated lower down, just above the junction with the floor; towards the posterior end this is a long, low, flat swelling (Pl. XII. fig. 14, *f.*), but further forward it gradually sinks down until it becomes a small rounded eminence; this corresponds to the bead-like tubercles on the floor of this ventricle in *Scyllium*, although it is here a ridge and not discrete formations.

The fourth ventricle passes beneath the cerebellum without any diminution in size (Pl. X. fig. 11); on the contrary, it gradually widens from behind forward; at this part a low broad tuberosity belonging to the trifacial is visible. Towards the anterior end of the cerebellum (Pl. XIII. fig. 10) this swelling disappears and the depression between the ventral columns loses its gentle contour and becomes a triangular trough, with the sides meeting at an angle at the bottom; here the lumen is more contracted, and its space is diminished by the projection of a process from the roof of the cerebellum.

In the ventricle (Pl. XI. fig. 9) of the mesencephalon or aqueduct of Sylvius the floor gradually deepens into a narrow fissure, which eventually opens into the infundibulum; in addition to the fissure in the floor of the optic lobe there is one in the roof which extends for the whole length of the lobe.

In the region of the anterior end of the optic lobe an offshoot of the fissure on the floor is observed to be directed backward; this can be traced beneath the floor of the optic ventricle for

some distance, and ends in a *cul-de-sac* immediately in front of the point where the infundibulum detaches itself from the under surface of the brain to pass down to the hypophysis.

From the point where the ventricle of the optic lobe joins the infundibulum the latter proceeds obliquely both upwards and downwards, upwards through a membranous tube to the epiphysis and downwards to the hypophysis; at the point of junction with this body the pia mater splits into two layers, one going to envelop the hypophysis, while the other passes over to the opposite side and shuts in the lower end of the infundibulum, so that there is no actual communication between this passage and the cavity of the hypophysis, as is the case in *Scyllium*; neither is this passage completed by nervous tissue, but the lower end is closed merely by this membrane.

Anteriorly the third ventricle communicates by means of a *ventriculus communis* with the two lateral ventricles in the cerebrum, the walls of which are completed by the tela choroidea; each of these again communicates anteriorly with a ventricle in the olfactory lobe.

MICROSCOPIC ANATOMY OF THE BRAIN.

Cerebrum.

On inspecting a section through the dorsal wall of the cerebrum (Pl. XIII. fig. 22) it is possible to make out four layers counting from the surface turned toward the ventricle, which is lined by an endothelium continuous with that of the remainder of the cavities of the brain. The cells of this endothelium send processes into the parenchyma of the cerebrum, and carry on their internal surface a flat disk, which, with those of the contiguous cells, form a membrane which lines the ventricle and in some places shows the remains of cilia.

The most internal of the four layers of the parenchyma of the cerebrum consists of cells which occupy about one quarter (more or less) of the thickness of the cerebral wall.

External to these cells the second layer, composed of a finely granular neuroglia, occupies rather more than one fourth of the total thickness.

The third layer consists of cells larger but much less numerous than those of the first layer.

The fourth or external layer is occupied by a zone of granular neuroglia, which extends to nearly half of the total thickness, filling the space between the third layer and the outer edge.

These measurements are approximative only and vary somewhat in different parts of the cerebrum.

The cells of the inner layer are generally spherical in shape, but some oval and pyriform ones are also met with and even occasionally fusiform ones are seen. They range in size from 0.0084 millim. to $13\ \mu$ in diameter; they show a peculiar tendency to become vacuolated, in which state they resemble the appearance presented by Infusoria when too much compressed; this vacuolation is caused probably by the preservative fluid not penetrating with sufficient quickness through the parenchyma, as it is only found in those cells which occupy the internal surface. When the cells are in this state the nucleus and the nucleolus are obscured; but in the normal cells they are quite distinct. These cells are closely crowded together and give off processes which join the fibrillar network of the neuroglia with which they are surrounded.

In the second layer the fibrils permeating the neuroglia of which it is composed have a decidedly longitudinal direction and are probably continuations of the fibres of the crura cerebri.

The cells of the third layer are on an average of a larger size than those of the first or internal layer; they range from $17\ \mu$ long and $14\ \mu$ wide to $30\ \mu$ long and $12\ \mu$ wide; they are not so closely packed together, but are rather sparsely scattered along the zone which they occupy; they usually give off two or three thick processes instead of numerous fine ones; they resemble the larger cells in the cerebrum of the Teleostei.

In some places the first or internal layer extends through the parenchyma of the second layer and becomes continuous with the third, so that the intervening neuroglia loses its distinct individuality and the three layers merge into one.

The fourth or external layer is entirely or very nearly devoid of cells, and consists of a fine fibrillar network imbedded in a finely granular neuroglia, having the usual characters and showing a slight tendency to radial striation.

The palissade cells of the external surface are very slightly developed and are scarcely perceptible; yet when they do occur they send processes into the interior, as in Plagiostomata and Teleostei.

The above-described arrangement occurs in the dorsal wall of the cerebrum. The ventral parietes forming the bullæ offer a slightly varying disposition of the elements of the nervous substance. Here the central layer of cells is absent, and only two layers are observable—one internal, composed of cells altogether resembling those which form the internal

layer in the dorsal walls; the other, made up of the ordinary neuroglia, extends to the outer surface; the line of demarcation between these two layers is irregular; sometimes isolated portions of neuroglia penetrate into the stratum of cells, and on the other hand groups of cells project into the neuroglia; the cells are arranged more loosely in some parts, in other places they appear to be more closely packed together. The stratum of neuroglia varies in width from one third to nearly one half of the thickness of the walls, the remainder of the space being occupied by the cells.

Lobi olfactorii.

In the structure of the olfactory lobes (Pl. XIII. fig. 21) one may distinguish four layers interposed between the endothelium, which lines the very large ventricles and which is continuous with that of the cerebrum, and the external surface.

Internally is seen a layer of cells resembling in every respect those of the inner layer of the cerebrum, with which they are continuous; their measurements also are very much about the same; they vary in diameter from $10\ \mu$ to $0\ 0145$ millim.

External to this layer of cells is a space occupied by a finely granular neuroglia, in which a fibrillar network is found having a general longitudinal direction. Longitudinal fibres of a larger size occur scattered through this layer; these are in some places collected into a bundle immediately internal to the outer layer; these fibres have fusiform cells developed along their course, which cells are of a larger size than those of the inner layer; their size varies from $0\ 0259$ millim. long and $0\ 0125$ broad to $12\ \mu$ long and $0\ 0098$ millim. broad; they follow the curves of the ventricle, so that they sometimes become visible in a transverse section, as in the figure.

As Fritsch has justly remarked, the glomeruli are as characteristic of the olfactory lobes as the Purkinje cells are of the cerebellum; they occupy the external part of the lobe in *Ceratodus*, as in Plagiostomata and Teleostei, and they present the same sort of structure. The fibrils which proceed from them constitute an external layer, which ultimately contributes to form the olfactory nerves.

At the anterior end of the ventricle there is a corresponding arrangement of the layers from behind forward, so that they surround the ventricle in concentric strata. Anteriorly the fibrils of the second layer form a distinct bundle, the outer fibrils of which go to a group of glomeruli situated in the centre of the anterior wall of the ventricle, while the inner fibrils pass over to the other side.

On comparing a section through the olfactory lobe with one through the cerebrum, it is possible to imagine how the former could have been evolved from the latter. The internal layer of the olfactory lobe resembles in every respect and is continuous with the internal layer of the cerebrum, the second and third layers of which would correspond to the middle layer of the olfactory lobe, while the glomeruli would be the condensed external layer of the cerebrum.

This idea is supported by the fact that the three internal strata of the cerebrum equal in width the two internal layers of the olfactory lobe, while the external layer of the former is much wider than the zone of glomeruli, which are undoubtedly formed of more condensed substance than the neuroglia of the cerebrum.

Hypoaria.

The hypoaria (Pl. IX. fig. 6) as distinct structures seem to be represented in *Ceratodus* only by the laminæ of nervous tissue which form the walls of the infundibulum.

Their structure resembles that of the cerebrum, that is to say, there exists a layer of cells on the inner surface, and external to this the parenchyma is occupied by neuroglia, in which a fine network of fibrillæ is imbedded.

The larger cells which characterize the third layer of the cerebral walls are here absent.

Lobi optici.

The optic lobes (Pl. XII. fig. 8, Pl. XIII. fig. 23) have a structure comparable to that of the optic lobes of the Plagiostomata. On the internal surface there is seen the layer of endothelial cells which line the aqueduct of Sylvius and are continuous with the endothelium of the remaining cavities of the brain.

External to the endothelium four layers may be distinguished in this structure.

The first is a layer of cells the great majority of which are spherical, but many are pyriform or oval; each sends a process from one side in a radial direction, which may be traced into the parenchyma of the interior of the lobe; the cells in this layer show a tendency to be arranged in clusters on these radial processes, in the same way as in the corresponding layer of the tectum lobi optici in Teleostei, but the arrangement is not so well marked here; many of them resemble the

cells of the internal layer of the cerebrum. Their size is about $16\ \mu$ in diameter.

Placed externally to these cells there is a zone of transverse fibrils which, proceeding upward, eventually collect into the transverse commissure on the dorsal part, to be mentioned presently; they are derived from fibres coming forward from the region about the floor of the ventricle, being originally derived from the lateral columns of the cord.

These two layers occupy about half the thickness of the section; many cells of the same size or larger than those of the first layer are seen to be scattered throughout this part, and, in addition, fusiform cells are to be found which are placed, some in a radial, others in a transverse, direction; the latter give a process from each end which joins the transverse fibrils; from the former processes run out to join the radial fibrils, which are visible traversing this stratum from the internal layer; these radial cells in some cases may be observed to give off from one end a comparatively broad process going towards the inner margin of the lobe, and from the other end of the cell a fine process which goes towards the outer surface and is soon lost in the parenchyma.

These cells measure from $28\ \mu$ to $32\ \mu$ in length and from $10\ \mu$ to $15\ \mu$ in breadth.

The third layer, counting from the internal surface, has a smooth, finely granular neuroglia, in which an extremely minute radial striation can be detected; it occupies about half the remainder of the section.

The fourth or external layer consists principally of longitudinal fibrils, which are the continuation of the fibres of the optic tract; in this zone a few cells are very sparsely scattered. The neuroglia in which these fibrils and cells are imbedded is coarser than that of the third layer and is permeated by a fibrillar network.

In the central line of the roof, close to the dorsal surface, there is a transverse commissure, formed of very fine fibrils, which are derived from the second layer of the optic lobe above described; it corresponds to the transverse commissure in the tectum lobi optici of Teleostei and the optic lobe of Plagiostomata.

Precisely in the region where this commissure occurs there is a ganglion of large cells (Pl. XII. fig. 8, *t. c. op.*), which corresponds to the roof-ganglion of Plagiostomata ("Dach-Kerne" of German authors). The greater number of these cells are in close apposition to the endothelium which lines the fissure present in the roof of the optic lobe; but a few are placed with their broad ends contiguous to the outer surface.

They are usually pyriform, having a process emerging from the pointed end, which process is directed radially, *i. e.* towards the inner surface, thus differing from the corresponding cells in the Plagiostomata, where the corresponding cells send processes in a transverse direction towards the outer side. There also occur others which have a fusiform shape; these send a process from each end, one being larger than the other. The fusiform specimens are found in the part of the ganglion which is situated close to the inner edge, while the pyriform ones are found near the outer edge. Their size varies between $82\ \mu$ long by $4\ \mu$ broad and $60\ \mu$ long by $5\ \mu$ broad.

These cells resemble the cells of the ventral ganglion of the spinal cord as to the nuclei and nucleoli, though differing much in shape. The nuclei are more deeply stained than the cell-contents, and the nucleoli have a clear space round them. Occasionally these cells exhibit two nucleoli, which are situated a short distance apart; in this case the clear space is single but elongated in shape, and meanwhile the nucleus remains unaffected; whether these were cases of cell-division I could not determine, the staining-fluid employed not showing any pattern of karyokinesis.

A ganglion containing cells which resemble these in form and position are found in the corpora quadrigemina of *Echidna*. This fact gives an additional argument in favour of the theory that the optic lobes of fishes homologize with the corpora quadrigemina of Mammals; as these bodies in *Echidna* are undoubtedly the same as in the Mammalia, so if the former correspond to the optic lobes in fishes, the latter must do so also, since things that are equal to the same are equal to each other.

At the posterior part of the optic lobe there is a problematical body (Pl. XII. fig. 8, *d*) which I have not met with elsewhere; it is situated at the outer and lower edge of the lobe, where it forms a swelling apparently attached to the outer side of the lobe, from which it is distinct. It consists of small spherical cells imbedded in a network with large meshes composed of fibrils; its signification is not apparent, but it appears to be connected with the transverse commissure of the medulla oblongata.

Cerebellum.

The cerebellum (Pl. XIII. fig. 10) has a structure corresponding to that found in Plagiostomata and Teleostei, and, indeed, of the whole vertebrate kingdom.

Four layers are to be distinguished from within outward viz. the fibrous, the granular, intermediate, and molecular.

The fibrous layer consists of nerve-fibres situated close beneath the endothelium; they run obliquely backward and eventually form the crura cerebelli ad medullam; some fibres also of this layer pass through the granular layer; they come up from the internal tuberosity on each side, then turn down along the main lamina of the cerebellum.

The granular layer occupies the space between the fibrous layer and the intermediate; it consists of spherical cells which are imbedded in a loose network of fibrillæ, to which they give off processes.

The intermediate layer, which comprises the Purkinje cells, is conterminous with the molecular layer, to which it might appear to belong; but as these cells send processes not only into the molecular but also into the granular layer, they might be said to belong to both; therefore it is perhaps better to make them into a separate layer, as they are structures characteristic of the cerebellum.

These Purkinje cells, as seen in a horizontal section, have a very irregular shape and give off numerous processes; some have five, four of which go more or less obliquely into the molecular layer, sometimes dividing dichotomously; the fifth in this specimen goes directly into the granular layer. In other cases these cells present a quadrangular form and show four processes, the long axis being placed radially or at right angles to the surface; in these forms two processes pass into the molecular layer and two into the granular; in one case one of the latter processes could be traced into the bundles of the fibrous layer. Other forms also are found, some with three processes and others only with two, the latter being fusiform in shape. The form of these cells in *Ceratodus* does not appear to be fixed, since they vary so much more than is the case in Plagiostomata and Teleostei.

In longitudinal and vertical sections these cells are more often fusiform or take on the shape of an isosceles triangle, which shows that they are more compressed in this direction; in the latter case the apex sends a process into the granular and the base sends two processes into the molecular layer.

At the anterior end of the cerebellum the molecular layer forms a mere cap on the summit of this segment of the brain; but on proceeding further back it is seen to extend laterally over the crura, carrying the other layers with it, but not extending so far over the restiform bodies as in some Plagiostomata; but where the latter become clear of the cerebellum

a small piece of the molecular layer is left on their summit, forming a sort of rudimentary resemblance between the two.

The molecular layer shows as its most conspicuous element the processes of the Purkinje cells, which pass towards the outer surface and there form a comparatively coarse network, which in some places gives a diamond-shaped pattern, like cross hatching; this is caused by the terminal branches of the processes dividing dichotomously at their extremities and so obliquely crossing each other; the fibrils resulting from this division are much larger than those which form a minute network, which fills up the intervals between them; the latter have a general tendency to a longitudinal direction, especially well marked towards the outer surface.

In addition to these two sets of fibrillar network there are to be found sparsely scattered through the molecular layer oval and rounded cells, some of which give off processes from their longer axis. The largest measure $23\ \mu$ long by 0.0155 millim. wide and their size varies between that and the smaller ones, which are 0.0155 millim. long by $13\ \mu$ wide. The spherical cells have the appearance of those found in the granular layer, and have about the same diameter, some being slightly larger. I could not make out that they gave off any processes.

In addition to these there occur also cells of a more elongated type, approaching the fusiform; these measure $24\ \mu$ long by 0.0114 millim. broad; they have a large granular nucleus, but no nucleolus can be detected; cells are also seen which form a transition to the oval shape.

Thus there is found in the molecular layer a regular transition from the spherical, passing through the oval, to the fusiform type of cells; the latter give off a process from each end, the one directed towards the outer surface being the thicker of the two and traceable as far as the outer edge, where it may be seen to join the network of the radial processes of the Purkinje cells.

Other cells are to be observed which are situated close to the outer edge; they resemble the oval type; in some places they form a thin layer.

The external surface of the cerebellum is bounded by an epithelium formed of rounded cells, which carry on their external surface flat membranous expansions, corresponding to but more substantial than those found on the inner surface facing the ventricle. This exterior layer of epithelial cells resembles the palissade cells ("Stiftzelle" of Stieda) in the Plagiostomata; but their processes which penetrate the molecular layer are much less marked.

Spinal Cord.

In a section through the spinal cord taken a short distance behind the posterior end of the sinus rhomboidalis the following structures may be distinguished:—

Three pairs of columns in the white substance, viz. the ventral, between the two ventral roots of the spinal nerves, the dorsal, between the two dorsal roots, and the lateral, between the dorsal and ventral roots.

The nerve-fibres of the ventral columns are on an average of a larger size than those of the other two columns; but they do not predominate to such a degree as in the Teleostei. On the other hand, many large-sized fibres are scattered through the lateral columns, which thus show a general average of larger-sized fibres than in Teleostei.

Contrary to what is the case in *Protopterus*, where the grey substance, according to Fulliquet*, repeats exactly the exterior form of the spinal cord, it here has a highly irregular outline. It extends on each side of the central canal in a semilunar form, the concavity being directed downwards; the two ventral horns expand into club-shaped extremities. The dorsal is more irregular in shape, consisting of lamellæ of grey substance, springing from the substantia gelatinosa centralis on each side of the canal and being directed towards the dorsal surface.

The grey substance gradually diminishes in going back until at the posterior end of the cord it nearly disappears.

The concavity of the grey substance coincides with the convexity of the ventral columns, on the summit of which the two multi-axial fibres are imbedded; these occupy a position corresponding to that of the Mauthner's fibres in Teleostei. As far as I can discover, they are distinct from any other kind of nerve-fibre in their structure, but seem to approach nearest to those fibres, of which they appear to be an amplification. They occupy a considerable amount of space on the upper and outer sides of the ventral columns, being conterminous with the lower concave edge of the grey substance on their dorsal sides. They vary in shape in different parts of their course from round to almond-shaped.

The peculiarity of their structure consists in the fact that from forty to fifty axis-cylinders are contained in a single medullary sheath, which is common to all of them. This sheath, notwithstanding its immense extent and thickness, has the appearance and structure of the medullary sheaths of

* *L. c.* p. 41.

ordinary nerve-fibres. The axis-cylinders also resemble those found in other parts of the cord.

Fulliquet *, who appears to have been the first to investigate microscopically the brain of *Protopterus*, describes two large fibres occupying a corresponding position in the spinal cord of that animal; these he terms Mauthner's fibres, but from his plates and the terms in which he mentions them, I should imagine that he refers to Müllerian fibres. The distinction is essential, for while the latter are unprovided with medullary sheaths, the former have them unusually well-developed.

The nerve-fibres of the ventral columns do not so manifestly exceed in size those of the lateral and dorsal columns as they do in Teleostei, consequently they are not so distinctly marked off in *Ceratodus*; the larger ones are accumulated more towards the dorsal edge of the column, those on the ventral side being smaller. There are many larger-sized fibres scattered throughout the lateral columns, while those of the dorsal columns are all of minute dimensions.

The ventral ganglion consists of fibrils, free nuclei, probably connective-tissue cells, and nerve-cells of two kinds; the fibrils pass through in all directions; many are continuous with the fibræ rectæ, which pass down in the central line to the ventral edge of the cord; these latter and many of the others are processes from the endothelial cells which line the central canal.

The nerve-cells are of two kinds: one species, gigantic in size and irregular in shape, is provided with numerous branches; the other smaller, smoother in contour, usually gives off not more than two processes.

The larger species (Pl. XII. fig. 18) are generally placed at the inferior edge of the ventral ganglion; some are elongated and curved, following the outline of the ventral horn of grey substance; they give off two or three processes from each end and four or five from their convex surface, which is inclined towards the white substance, while none are sent off from their concave margin, which embraces the grey substance. These cells are not very numerous; sometimes only one or two are to be seen in a section; these are of the largest size. Occasionally as many as five occur in one section, but never more; in this case they are smaller and are narrow, fusiform, or tripolar, and occupy a position near the edge and also sometimes more in the interior of the ventral horn.

The processes from these cells can be followed for long distances, and can be seen to give off branches, which pass between the trabecular network which forms the supporting

* L. c. p. 43.

framework of the cord; some of them can be traced occasionally to the outer edge of the section, where they are found to pass into the longitudinal columns, where they become the finer longitudinal fibres which are to be seen in that position; others can be traced to the centre of the motor tract, where they become the fine fibres which occupy the spaces between the usual larger-sized fibres of the ventral and lateral columns; in most cases these processes of the cells turn backward, in a few they turn forward. In one case I found a process from a cell turning backward in the ventral column and another process from the same cell turning forward in the dorsal part of the lateral column; occasionally a process may be traced into the ventral column of the opposite side of the cord; sometimes a branch is traceable into the *substantia gelatinosa centralis*, passing dorsad of the multiaxial fibre.

Cells (Pl. XII. fig. 18) with two nuclei are occasionally to be found, each nucleus being provided with a nucleolus; perhaps these cells may be more properly regarded as two distinct cells connected together by a short thick process.

Cells of the other species are found in the *substantia gelatinosa centralis*, where they form a ganglion corresponding in position to the central ganglion in *Teleostei*; they are smaller in size and present a smoother and more regular contour than those in the ventral horn; they are flask-shaped or oval, and usually give off one or two processes; their long axis is generally turned towards the dorsal edge. Although no positive connexion could be traced between them and the fibres of the dorsal root, yet the probability is that they unite and that this ganglion belongs to that root. Cells of this species are also found grouped in the *fibræ rectæ*; one such ganglion is found in this position immediately behind the posterior end of the *sinus rhomboidalis*. Cells resembling these, but slightly smaller, are occasionally found singly scattered through the field of the ventral columns; they differ, however, in giving off more than one process.

The multiaxial fibres (Pl. XI. fig. 19) commence at the posterior end of the spinal cord and are first met with opposite the hinder end of the abdomen; here they consist of a very few axis-cylinders enclosed in a comparatively small medullary sheath; the axis-cylinders gradually increase in number as the fibres proceed forward, but the increase is not uniform; at about the middle of their course they become much smaller, and after a few sections again enlarge to the original diameter. But this diminution does not occur at the corresponding point on the opposite sides; but the fibre of one side first suffers a diminution, then that of the other side.

Occasionally axis-cylinders may be seen escaping singly or in groups, passing through the medullary sheath, without diminution of size, into the field of the ventral columns. This fact accounts for the diminution of size at various points in the course of the fibres.

The shape of the multi-axial fibres varies according to the part of the spinal cord in which they are observed; at the posterior end they are elliptical, towards the centre they are round, and further forward they are almond-shaped.

Some distance behind its anterior termination (Pl. X. fig. 13) one axis-cylinder has become distinguished from the remainder by its greater consistency, and by its taking the staining-fluid more readily; in some places it becomes clothed with a special medullary sheath, which, however, soon disappears and is not visible in every specimen.

At a short distance posterior to the point where the facial emerges from the brain this axis-cylinder is the only one remaining, all the others having disappeared, the whole fibre having in the meantime gradually diminished in size. The fibre has now quite the appearance of the Mauthner's fibre of the Teleostei, consisting as it does at this point of a single large axis-cylinder surrounded by a thick medullary sheath. Immediately in front of this spot the axis-cylinder of one side decussates with that of the other, the place corresponding with the position of the decussation of the Mauthner's fibres in the Teleostei. After the decussation the two axis-cylinders, still surrounded by the medullary sheath, are to be seen pursuing a course beneath the floor of the fourth ventricle towards the external edge, and can be traced, with the exception of a very small gap, into the root of the facial. Fulliquet* describes a decussation of the fibres which he terms "Mauthner's" at a corresponding place in *Protopterus*; but their destination according to him, although he does not appear to be quite certain on the point, is somewhat different, as he says that they go to the sixth root of the acusticus. While the multi-axial fibre is diminishing in size its place in the ventral column is taken by an increasing number of fibres, which are most probably the axes that have escaped from that body; their destination, as will appear presently, is to form part of the root of the acusticus.

In seeking for the signification of these multi-axial fibres it will be as well to consider what nerve-fibres other nearly-related animals possess. We have in Teleostei the well-known Mauthner's fibres, which occupy a corresponding

* *L. c.* p. 82.

position and which occur also in *Axolotl**; in these cases the fibres, two in number, have each only one axis-cylinder; but as in *Ceratodus* there are an indefinite number, the homology is not complete; but in *Petromyzon* there are a large number of naked axis-cylinders occupying the ventral columns: these, according to Ahlborn †, are divided into three groups, two median and one lateral, on each side; one fibre of the median group decussates with another of the opposite side at a spot corresponding to where the multiaxial fibre decussates and joins the upper acusticus root; he is not certain about the destination of the remainder of the median group, but the lateral group passes on without decussating and joins the lower acusticus root: thus we have simply to enclose the Müllerian fibres in a medullary sheath and we have the multiaxial fibre; the conclusion is therefore obvious that this fibre is the homologue of the Müllerian fibres of *Petromyzon*.

The ventral columns of the spinal cord pass forward, and spreading out on the ventral edge of the aqueduct of Sylvius, are ultimately lost in the walls of the third ventricle or region of the thalamus; anteriorly they are separated from the crura cerebri by the ventral transverse commissure.

The crura cerebri appear to go principally into the lateral columns or lateral part of the ventral columns; the outer portion of the former furnish the crura cerebelli and also further forward they send fibres into the second layer of the optic lobe.

In the spinal cord the only transverse commissure to be found runs through the substantia gelatinosa immediately above the central canal.

At the posterior end of the medulla oblongata a transverse commissure is seen close to the ventral edge; it first appears in the funnel-shaped backward prolongation of the sinus rhomboidalis, and gradually increases both in lateral and vertical extent; more anteriorly it arrives at its greatest development at the region of exit of the trigeminus group of nerves, the opposite sides of which it serves to connect, as also the region of the vagus. During this course it comes to occupy nearly the whole of the motor tract. But this is not its termination, for it can be traced further forward; at the anterior end of the cerebellum it has become much smaller, but beneath the posterior end of the optic lobe it again increases in size and appears to contribute to the network found in the problematical body (Pl. XII. fig. 8, *d*) on the outer side of the optic lobe;

* Stieda, Zeitschr. f. wiss. Zool. Bd. xxv.

† L. c. p. 263.

passing through this body and having arrived at its dorsal end its fibres, or some of them, pass into the optic lobe to join the fibres from the lateral columns of the cord; together they enter the second layer and contribute to form the transverse commissure in the mid line on the dorsal edge of this lobe. The whole seems to correspond to the commissura ansulata of Teleostei.

At and slightly posterior to the exit of the oculomotores this commissure has nearly disappeared, only again to increase in size until it terminates at the posterior end of the *cul-de-sac* which projects a short distance behind the infundibulum; in its course at this part it connects the two sides of the aqueduct of Sylvius, at the part which probably homologizes with the thalamus opticus. This commissure is on the ventral side of the brain; on the dorsal side also there is another commissure, which, commencing at the posterior border of the third ventricle, is continuous backward with the commissure in the roof of the optic lobe; it is the posterior commissure which is found both in Teleostei and Plagiostomata, and corresponds both in position and general arrangement with the posterior commissure in the third ventricle of the Mammalia.

On each side of the fissure on the ventral side of the aqueduct of Sylvius, close behind its entrance into the third ventricle, there is a ganglion containing moderate-sized cells from which a few fibres pass back and ultimately join the anterior prolongations of the ventral columns of the cord.

Deep Origins of the Cranial Nerves.

Optic Nerves.—There is no chiasma nervorum opticorum visible externally, but internally there is at the base of the thalamencephalon a complicated decussation of fibres. Some go from one nerve to the other side, some of the dorsal fibres go from one nerve to the other, but none could be seen to go from the nerve to the optic tract of the same side.

The optic tract passes upward and forward along the external edge of the thalamencephalon until it reaches the optic lobe, where its fibres spread out longitudinally, forming the outer layer of fibres in that structure.

Oculomotores (Pl. XII. fig. 8, n. 3).—As Ahlborn has pointed out in *Petromyzon*, this nerve arises from the under surface of the medulla oblongata; although the position of its ganglion is beneath the floor of the aqueduct of Sylvius, yet this is part of the anterior prolongation of the medulla oblongata. In *Ceratodus* it corresponds in position and mode of origin with the same nerve in Teleostei and Plagiostomata.

Patheticus (Pl. XI. fig. 9, n. 4).—The trunk of this nerve was not discovered, but that it exists is shown by the fact that its decussation and part of its course and exit is to be seen in the transverse section of the valve of Vieussens, that is to say, in the connecting-link between the cerebellum and the optic lobe.

Trifacial (Pl. X. fig. 11, n. 5).—The anterior root of the trifacial is derived from a ganglion situated at the external edge of the floor of the fourth ventricle, where it forms a flat broad swelling, which occupies the space between the ridge of the ventral column and the corpus restiforme; this swelling is visible on macroscopic inspection; from this ganglion the fibres proceed directly downward and outward to emerge at the inferior external angle of the medulla oblongata; it corresponds to the anterior origin in *Teleostei*, but the root has a more direct course to its exit.

The posterior roots of the trifacial have a single origin, which divides into two trunks immediately outside the brain. The origin is from the tuberosity on the summit of the restiform bodies, constituting part of the continuation of the molecular layer of the cerebellum, which passes on to those bodies where the crura cerebelli are detached; there are here a few medium-sized cells from which its fibres might be derived, but it is principally composed of somewhat coarsely granular neuroglia and numerous fibrils. A bundle of fibres (Pl. XII. fig. 12) from this tuberosity passes down the inner margin of the restiform body, crosses the origin of the facial, and is lost in the field of the medulla oblongata with the transverse commissure which occupies that part.

Facial (Pl. XII. fig. 12, n. 7).—This nerve passes into the cord at the inferior external angle in an upward and inward direction until it reaches the angle formed between the floor and the walls of the fourth ventricle, at which point one part of it passes backward as a well-defined bundle in a small tuberosity, in which it can be traced backward for a long distance, and is eventually lost in the grey matter of the tuberosity at about the middle of the ventricles.

The remainder of this nerve has a more direct origin from the grey matter of the lower part of the wall of the ventricle, beyond which this part cannot be traced.

Acusticus (Pl. XII. fig. 12, n. 8).—This nerve, arising below the facial, passes obliquely upward and inward until it reaches the floor of the fourth ventricle at a point some distance internal to the facial. On attaining the grey matter of the floor of the ventricle ("Bodengrau" of German authors) it turns towards the mid line until it arrives at the margin of

the ventral column, running close beneath the endothelial lining of the floor; arrived at the summit of the ventral columns, it appears to turn back, and is traceable for some distance as a bundle of fibres smaller than the remainder, which I have reason to believe become part of the multiaxial fibre; in its course along the floor this nerve traverses a collection of cells from which some of its fibres may be derived.

Vagus (Pl. XII. fig. 14, n. 11).—The first root arises from the outer angle of the medulla oblongata at some distance behind the exit of the acusticus, but at a slightly higher level; it passes into the floor of the ventricle, where it enters the tuberosity which contains the tract of the facial; the tuberosity enlarges for its reception; it then passes back close to the outer side of that tract. After the disappearance of the facial the tuberosity becomes larger and is composed of finely granular neuroglia; the dorsal part is occupied by cells in which the bundle in question disappears.

This tuberosity extends nearly to the posterior end of the fourth ventricle and receives in succession the remaining roots of the vagus, which are all derived from the same origin; it is continuous, and not discrete, as in *Scyllium* and *Acanthias*. There are five roots discernible, the three posterior of which are double, although the external nerve resulting is single; this would make the trunk of the vagus equivalent to eight nerves. All these roots are dorsal, and in this species there are no ventral roots. Behind the last root of the vagus two nerves are given off which have only ventral roots; they arise in precisely the same way as the ventral roots of the spinal nerves, the only difference being that they have each two roots in the medulla oblongata. In *Ceratodus* at least they do not belong to the vagus.

Spinal Nerves.—The dorsal roots enter the spinal cord at a point close to the mid line, but they diverge as they pursue their course through the parenchyma, so that in the interior of the cord they are further from the central line than they are at their point of emergence. The individual fibres are of a large size, equalling those of the ventral root. The entering fibres turn forward in the substance of the cord, immediately outside the grey substance of the dorsal horn.

The ventral roots, after entering the cord, follow a forward and upward course towards the inner edge of the multiaxial fibre, usually passing between that fibre and the central canal over its dorsal edge; they are lost in the grey matter at its outer angle. Sometimes a fibre belonging to this root may be traced, after having followed the path above mentioned in a longitudinal direction, into one of the fibres of the

ventral column situated between the outer edge of the multi-axial fibre and the ventral horn of grey substance. In one case a fibre from the ventral root was seen to join a process from one of the large ventral ganglion-cells after having followed a similar course.

CONCLUSION.

As far as the brain is concerned *Ceratodus*, as Prof. Huxley has already remarked, holds a somewhat central position.

This animal having such an archaic form and differing so little from its predecessors of the Carboniferous epoch in structure, it is interesting to note the embryonic condition of its brain, as shown in three points:—first, the extreme size of its ventricles, which are surrounded by a very thin layer of nervous tissue; second, the alternating dorsal and ventral roots of the spinal nerves; and third, the origin of the dorsal roots of the spinal nerves in close proximity to the central line.

Ceratodus presents points of contact with all the principal divisions of the class, and it does not appear to approximate more to its nearest congener, *Protopterus*, as far as the brain is concerned than to other members of its class. While it differs from *Protopterus* in the shape and imperfection of its cerebral lobes, it agrees in the general contour and in the narrowness of the mesencephalon and the breadth of the medulla oblongata, as also in the rudimentary character of the cerebellum, which is a mere bridge over the sinus rhomboidalis, although it is much larger in *Ceratodus* than in *Protopterus*. The former also differs in having a well-developed olfactory lobe, which is not present as a distinct structure in *Protopterus*.

With regard to the other orders of this class *Ceratodus* agrees with the Ganoids in the comparative narrowness of the mesencephalon and thalamencephalon and the proportions of the cerebellum.

With the Plagiostomata it agrees in the structure of the optic lobes and in the size and mode of attachment of the olfactory lobes to the cerebrum, a fact which was shown by Prof. Huxley. It can scarcely be said that they agree in the structure of the prosencephalon, since in the Plagiostomata the ventricles are perfect and the nervous tissue well developed, whereas in *Ceratodus* the ventricles are imperfect and the nervous tissue scanty.

With the Teleostei the only point of contact appears to be the multi-axial fibres, although these present a large measure

of dissimilarity in the greater part of their course; yet at their anterior end they show a similarity both in their appearance when only one axis-cylinder remains enclosed in the medullary sheath, and also in the fact of their decussation and in the position of that decussation.

With *Petromyzon* the only points of contact are the tela choroidea, which covers in the fourth ventricle, and the multi-axial fibre; the tela choroidea appears to have the same sort of structure, and if my supposition be correct the multi-axial fibre represents a more advanced stage of development of the Müllerian fibres.

With regard to the other division of the class Ichthyopsida, viz. the Amphibia, there seem to be as many points of difference as agreement, so that from the point of view of the structure of the nervous system *Ceratodus* appears to be quite isolated, and while presenting some agreement in structure with all the members of the class Pisces, is nearly related to no one of them.

EXPLANATION OF PLATES VIII.-XIII.

The following letters have the same signification throughout:—

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|---|--|
| <i>a. c.</i> Anterior commissure. | <i>f. a.</i> Fibres belonging to the acusticus. |
| <i>aq. sy.</i> Aqueduct of Sylvius. | <i>f. f.</i> Fasciculus of the root of the facial nerve. |
| <i>b.</i> Nervi branchiales. | <i>f. l.</i> Fibrous layer of the cerebellum. |
| <i>b. ce.</i> Inferior bulla of the cerebrum. | <i>g. l.</i> Granular layer of the cerebellum. |
| <i>c. a.</i> Commissura ansulata. | <i>gl. o.</i> Glomeruli olfactorii. |
| <i>c. c.</i> Crura cerebri. | <i>gn. h.</i> Ganglion Habenulæ or tuberculum intermedium. |
| <i>c. ca.</i> Central canal of the spinal cord. | <i>gn. r. op.</i> Ganglion of the roof of the optic lobe. |
| <i>c. cbl.</i> Crura cerebelli ad medullam. | <i>gn. th.</i> Ganglion of the thalamencephalon. |
| <i>cbl.</i> Cerebellum. | <i>gn. tri.</i> Ganglion of the trifacial. |
| <i>ce.</i> Cerebral lobes. | <i>gn. v.</i> Ganglion of the vagus. |
| <i>c. g.</i> Cells of the central ganglion. | <i>i. l.</i> Internal layer of the olfactory lobe. |
| <i>ch. op.</i> Chiasma nervorum optico- rum. | <i>i. m.</i> Inferior maxillary nerve. |
| <i>ch. te.</i> Tela choroidea. | <i>in.</i> Infundibulum. |
| <i>co.</i> Communicating branch between the trifacial and the vagus. | <i>l. c.</i> Lateral columns of the cord. |
| <i>co. p.</i> Communicating branch between the glossopharyngeal and vagus ganglion. | <i>m.</i> Combined superior and inferior maxillary nerve. |
| <i>c. v. g.</i> Cells of the ventral ganglion. | <i>m. ce.</i> Mesencephalon. |
| <i>d. h.</i> Dorsal horn of the grey substance. | <i>m. l.</i> Molecular layer of the cerebellum. |
| <i>d. l.</i> Dorsal longitudinal columns. | <i>mlt.</i> Multi-axial fibre. |
| <i>d. r.</i> Dorsal roots of the spinal nerves. | |
| <i>e.</i> Epiphysis. | |

- m. ob.* Medulla oblongata.
m. th. Mesethmoid cartilage.
n. 2. Optic nerves.
n. 3. Oculomotor nerves.
n. 4. Trochleares nerves.
n. 5. Trifacial nerves.
n. 7. Facial nerves.
n. 8. Acusticus.
n. 9. Glossopharyngeal.
n. 10. Vagus.
o. Ophthalmic nerve.
ol. o. Olfactory sac.
op. l. Optic lobe.
op. tr. Optic tract.
pa. Palatine nerve.
p. c. Posterior commissure.
pi. Hypophysis cerebri.
p. m. Pia mater.
p. p. Process of the pterygopalatine bone.
pr. Prosencephalon.
r. c. Restiform column.
rh. Rhinencephalon.
r. i. Ramus intestinalis.
r. l. Ramus lateralis.
s. g. c. Substantia gelatinosa centralis.
sp. gn. Spinal ganglion.
sp. n. Spinal nerve.
s. r. Sinus rhomboidalis or fourth ventricle.
t. c. op. Transverse commissure of the optic lobe.
th. Thalamencephalon.
t. i. Tuberculum intermedium.
t. tri. Tuberosity of the trifacial.
t. v. Tuberosity of the vagus.
v. c. Ventriculus communis.
v. h. g. Ventral horn of grey substance.
v. l. c. Ventral longitudinal column.
v. r. Ventral roots of the spinal nerves.
v. t. c. Ventral transverse commissure.
v. th. Third ventricle.
v. v. Valve of Vieussens, valvula cerebelli, or anterior medullary velum.

Fig. 1. Dorsal view of the brain, with the distribution of the nerves, as far as can be seen on that aspect; right side shows the superficial nerves, left side the deeper nerves, natural size.

Fig. 2. Side view of the brain, with part of the skull in outline, nat. size.

Fig. 3. View of the brain from below, nat. size.

[Transverse sections arranged in consecutive order from before backward.]

Fig. 4. Transverse section through the prosencephalon immediately behind the point where the two sides become entirely separated from each other, $\times 6\frac{1}{2}$.

Fig. 5. Transverse section through the anterior part of the thalamencephalon with the chiasma of the optic nerves and the crura cerebri, $\times 8\frac{1}{2}$.

Fig. 6. Transverse section through the posterior end of the thalamencephalon and the infundibulum, $\times 8\frac{1}{2}$.

Fig. 7. Transverse section through the anterior end of the aqueduct of Sylvius, at the point where the infundibulum becomes clear of the inferior surface of the brain, $\times 8\frac{1}{2}$.

Fig. 8. Transverse section through the mesencephalon at the point where the oculomotores emerge, $\times 14$.

Fig. 9. Transverse section through the valve of Vieussens, showing decussation of the fourth nerve and posterior edge of the optic lobe, $\times 14$.

Fig. 10. Transverse section through the cerebellum, $\times 14$.

Fig. 11. Transverse section through the origin of the anterior root of the trifacial nerve, $\times 14$.

Fig. 12. Transverse section through the sinus rhomboidalis at the point of apparent origin of the posterior root of the trifacial, facial, and acusticus, $\times 14$.

- Fig. 13.* Transverse section through the sinus rhomboidalis at the point where the multi-axial fibre decussates.
- Fig. 14.* Transverse section through the sinus rhomboidalis at the apparent origin of the vagus, $\times 14$.
- Fig. 15.* Transverse section through the spinal cord a short distance behind the fourth ventricle. Some of the detail was added from another specimen. $\times 24$.
- Fig. 16.* Transverse section through the middle portion of the spinal cord, $\times 24$.
- Fig. 17.* Transverse section through the posterior part of the spinal cord, $\times 24$.
- Fig. 18.* Two cells from the ventral ganglion of the cord: *v*, the side turned towards the ventral edge; *d*, the side turned towards the dorsal edge; the grey substance of the ventral horn is situated between the two on the concave side of the upper and on the convex side of the lower cell. $\times 65$.
- Fig. 19.* Section through the multi-axial fibre: *m. s.*, medullary sheath; *a. c.*, axis-cylinders; *b*, the axis-cylinder destined to decussate. $\times 120$.
- Fig. 20.* Cells from the roof-ganglion of the optic lobe, $\times 180$.
- Fig. 21.* Transverse section through the olfactory lobe, $\times 180$.
- Fig. 22.* Longitudinal and vertical section through the dorsal part of the cerebrum, $\times 180$.
- Fig. 23.* Transverse section through the optic lobe, $\times 180$.

XIX.—*New Genera and Species of Trichopterygidæ.*

By REV. A. MATTHEWS.

THE Trichopterygidæ have numerically increased to such an extent since the publication of the '*Trichopterygia Illustrata*' in 1872, that I have for some time contemplated adding a second part to that work. Many of the new species have been already described in various periodical and other works, but some few still remain unnoticed. And since the publication of a more comprehensive work has hitherto been, and may yet be, retarded by causes over which I have no control, I propose in the following pages to give a short summary of their chief distinctive characters, reserving more detailed descriptions to some future period.

The two new genera described in this paper are both of a most extraordinary and novel character, and extremely elegant in form. In *Mikado* the front of the head is produced into an elongated snout or rostrum, after the manner of some species of *Rhinosimus*; but this part is deflexed, and, when at rest, laid upon the prosternum, so that, if viewed from above, the head presents the appearance usual to *Trichopteryx*. In *Dimorphella*, as its name implies, the sexes would appear

generically distinct; the males, except that their elytra are slightly truncate at the extremities, resemble *Ptenidium* or *Camptodium*, while the females, with short elytra and elongate abdomen, look like *Ptinella*. Of the sixteen new species eight have been discovered by the researches of Herr E. Reitter; two only are British, and the rest come from various parts of the world and from many different collectors.

MIKADO, gen. nov.

Corpus obconicum, postice valde attenuatum, convexum.

Caput sat magnum, antice valde elongatum, rostriforme, fortiter deflexum.

Antennæ modicæ, 11-articulatæ, clava biarticulata.

Palpi maxillares parvi, gracillimi, 4-articulati.

Palpi labiales sat magni, triarticulati, moniliformes, setis longis ad apices instructi.

Labrum magnum, suboblongum.

Mandibulæ sat angustæ, apicibus bidenticulatis.

Maxille magnæ, robustæ, quasi trilobatæ, lobo inferiore elongato, ad apicem dentibus curvatis, acutissimis armato.

Mentum modicum, fere quadratum.

Labium suboblongum, ad apicem in processu paraglossali longo, acuto, divergente utrinque productum.

Lingua parva, apice bifido.

Pronotum magnum, ad basim latissimum, angulis posterioribus maribus parum productis.

Scutellum late triangulare.

Elytra elongata, apicibus oblique truncatis.

Alæ lanceolatæ setis marginalibus prælongis instructæ.

Venter segmentis sex compositus apicali integro.

Pedes sat breves, graciles; tarsis triarticulatis, coxis posterioribus late laminatis, fere contingentibus.

This genus is allied to *Myrmecotrichis*, but distinguished from that and from all other genera by its rostriform head.

Mikado japonicus, sp. nov.

L. c. 0.50 mm. Obconicus, elongatus, postice validissime attenuatus, nitidus, flavus, pilis brevibus aureis vestitus; capite magno, antice rostriformi, oculis nigris, valde prominentibus; pronoto sat magno, ad basim latissimo, glabro, nitidissimo; elytris ad humeros latissimis, postice valde attenuatis, remote asperatis, apicibus oblique truncatis; abdominis segmentis duobus apertis; pedibus atque antennis brevibus, flavis.

This interesting species was found by Mr. Lewis near Yuyama, Higo, Japan. From the anatomy of its mouth *Mikado*
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appears to be carnivorous, and was probably inhabiting the fungus in which it occurred rather plentifully for the purpose of preying upon the eggs and young larvæ of minute animals, which the peculiar shape of its head would enable it to extract from the cells without difficulty.

DIMORPHELLA, gen. nov.

Corpus subovatum, valde convexum.

Caput prominens, antice sat productum.

Antennæ longæ, graciles, 11-articulatæ, clava tenui, triarticulata.

Palpi maxillares robusti, 4-articulati, articulo apicali brevi, aciculari.

Palpi labiales perbreves, triarticulati, articulis transverse subquadratis, apicali setis erectis longissimis ad apicem instructo.

Labrum magnum, latum, subquadratum.

Mandibulæ sat longæ, obtuse uncinatæ.

Maxillæ permagnæ, robustæ, quasi trilobatæ, lobo interiore valido, dentibus multis, curvatis, acutissimis armato.

Mentum magnum, oblongum.

Labium oblongum, sub mento ferme occultum, in processu paraglossali brevi, acutissimo, divergente ad apicem utrinque productum.

Lingua perbrevis, lata, apice profunde bifido.

Pronotum parvum, angustum, ad basim fortiter constrictum, pone medium latissimum atque in maribus dente acuto, magnitudine variabili ad latera armatum, margine basali recta angulis salientibus.

Scutellum magnum, triangulare.

Elytra magna, tumide convexa, extremis truncatis, femineis multum abbreviata apicibus truncatis.

Alæ angustæ, lanceolatæ, setis marginalibus instructæ.

Venter segmentis sex compositus, apicali integro.

Pedes sat longi, graciles; tarsis triarticulatis, coxis posterioribus magnis, sat remotis, late laminatis.

Dimorphella does not appear to be intimately allied to any other genus; the males bear some resemblance in outward form to *Pterycodes* and the females to *Ptinella*, and for that reason it should, I think, be placed in the vicinity of one or other of those genera.

Dimorphella Reitteri, sp. nov.

L. c. 0.63-0.75 mm. Subovata, valde convexa, nitidissima, vel flava, vel rufo-castanea, pilis aureis sparse vestita; capite modico, antice producto, oculis valde prominentibus; pronoto capite multum latiore, ad medium latissimo atque in maribus dente acuto laterali armato, basim versus fortiter constricto, margine basali recta angulis salientibus; elytris capite atque pronoto multum et

lterioribus et longioribus, ante media latissimis, in maribus tumide incrassatis et punctis foveolatis profunde impressis, apicibus extremis truncatis, in femineis modice convexis et multum abbreviatis; antennis prælongis, gracillimis, atque pedibus læte flavis.

In a collection of Trichopterygidæ made by Herr Blumenau in Brazil and kindly presented to me by Herr E. Reitter I found four males and two females of this beautiful insect and several of the other novelties which I now describe; but I regret to add that there was no note of the precise locality or the conditions in which they were found.

Ptinella brasiliiana, sp. nov.

L. c. 0.75–0.87 mm. Elongato-ovalis, sat depressa, nitidula, modice punctata, haud tuberculata, pilis aureis vestita, mascula læte flava, feminea castanea, abdomine flavescente atque alis nigris visis; capite magno, antice rotundato, oculis mas. nullis, fem. nigris; pronoto modico, capite parum latiori, ante medium latissimo, ad basim leviter contracto, in disco profunde impresso; clytris capite atque pronoto longioribus et lterioribus, ad media latissimis, profunde asperatis, apicibus valde rotundatis; abdomine flavescente segmentis quinque apertis, apicali obtuso; pedibus atque antennis longis, læte flavis.

One male and one female found by Herr Blumenau in Brazil.

Trichopteryx caucasica, sp. nov.

L. c. 1.12 mm. Late oblonga, valde convexa, nitidula, sat rugose tuberculata, pilis aureis vestita, rufo-picea, clytris rufescentibus; capite magno, nigro, oculis parvis, haud prominentibus; pronoto magno, nigro-piceo, ad basim latissimo, capite multo latiore, tuberculis magnis ornato, angulis posterioribus longe productis; clytris fere quadratis, capite atque pronoto parum angustioribus, profunde asperatis; abdomine rufescente, apice bidentato; pedibus atque antennis sat longis, læte flavis.

This species was taken not unfrequently in the region of the Caucasus by Herr Leder; it is chiefly distinguished by its large size, dilated thorax, quadrate elytra, and coarse sculpture.

Trichopteryx hellenica, sp. nov.

L. c. 0.87 mm. Oblonga, valde convexa, nitidissima, pilis flavis vestita, rufo-picea, remote tuberculata; capite magno, oculis parvis; pronoto magno, valde convexo, nitidissimo, capite multum latiore, ad basim latissimo, tuberculis parvis remote ornato, mar-

gine basali leviter arcuata angulis latissimis longe productis; elytris brevibus, parum attenuatis, capite atque pronoto brevioribus et angustioribus, modice et remote asperatis, apicibus dilutioribus; abdomine castaneo; pedibus atque antennis sat brevibus, rufescentibus.

T. hellenica differs from the preceding species in its much smaller size, very convex and shining thorax, and faint sculpture. It is in the collection of Herr E. Reitter, and was found in the Morea.

Trichopteryx truncatissima, sp. nov.

L. c. 0.75 mm. Brevissima, postice validissime attenuata, convexa, rugose exsculpta, nigra, pilis fulvis dense vestita; capite magno, oculis magnis, haud prominentibus; pronoto magno, ad basim latissimo, rugose tuberculato, angulis posterioribus latis, longe productis; elytris perbrevibus, fusciscentibus, postice validissime attenuatis, capite atque pronoto multum brevioribus et multum angustioribus, profunde asperatis, apicibus dilutioribus, extremis albidis; abdomine nigro; pedibus robustis, kete flavis; antennis gracilibus, obscure flavis.

Three specimens of this very distinct and remarkable species were found in Brazil by Herr Blumenau; it is easily recognized by its broad thorax and short and excessively attenuated elytra.

Trichopteryx angusta, sp. nov.

L. c. 0.80 mm. Elongata, valde angusta, convexa, nitida, nigra, pilis fulvis sparse vestita; capite magno, oculis modicis; pronoto parvo, capite latiore, ad basim latissimo, indistincte tuberculato, nitido, margine basali fere recta angulis productis, acutissimis; elytris fusciscentibus, perbrevibus, capite atque pronoto brevioribus et angustioribus, ad humeros latissimis, sat profunde asperatis, apicibus obtusis; abdomine elongato segmentis quinque apertis, nigro, apice obtuso, integro; pedibus kete, antennis obscure flavis.

This species may be distinguished from others by its intermediate size, long and narrow form, very short elytra, and long abdomen.

Three specimens were found by myself in Leicestershire.

Trichopteryx brasiliensis, sp. nov.

L. c. 0.75 mm. Suboblunga, convexa, nitida, fortiter cælata, fuscens, pilis fulvis vestita, atque setis lateralibus erectis in-

structa; capite magno, lato, oculis parvis; pronoto sat magno, ante basim latissimo, fortiter tuberculato, seta erecta laterali pone medium utrinque instructo, angulis posterioribus modice productis; elytris brevibus, quadratis, capite atque pronoto multum brevioribus, parum angustioribus, profunde asperatis, setis duabus erectis, nigris ad latus utrumque instructis, apicibus fere rectis; abdomine rufo-fusco; pedibus robustis, læte flavis; antennis obscure flavis.

Differs from other species in its short quadrate elytra, thorax widest before the base, rufescent abdomen, and short, erect, lateral setæ.

Found in Brazil by Herr Blumenau.

Trichopteryx reticulata, sp. nov.

L. c. 1·25 mm. Brevis, lata, valde convexa, nitida, elytris strigose asperatis, fusco-picea, pilis brevibus aureis vestita; capite magno, lato, umbilicatum punctato, oculis sat prominentibus; pronoto sat magno, capite multum latiore, ad basim latissimo, punctis umbilicatis confertim impresso, margine basali leviter arcuata angulis latis productis; elytris brevibus, subquadratis, pronoto angustioribus, reticulatum et strigose asperatis, apicibus rotundatis; abdomine sat longo, umbilicatum punctato, atque reticulato, apice integro; pedibus atque antennis læte flavis.

Differs from all other species in its strigose and very peculiar sculpture.

Found in Brazil by Herr Blumenau.

Trichopteryx Darwinii, sp. nov.

L. c. 0·63 mm. Oblonga, convexa, nitidula, modice tuberculata, tota castanea, pilis sat longis aureis vestita; capite modico, oculis parvis; pronoto brevi, ad basim latissimo, tuberculis parvis remotis ornato, angulis posterioribus vix productis; elytris sat brevibus, quadratis, pronoto vix latioribus, postice latissimis, modice asperatis, apicibus fere rectis; pedibus flavis, antennis gracillimis, pallide flavis.

This species differs from *T. brevis* in its broader form, shorter thorax, very slender antennæ, and finer sculpture. I feel much pleasure in dedicating this insect to the memory of the late C. R. Darwin, by whom it was found in a fungus near Rio Janeiro.

Trichopteryx tesserula, sp. nov.

L. c. 0·63 mm. Brevissima, quadrata, sat depressa, nitidula, pilis pallidis vestita, fusca; capite permagno, antice producto, oculis parvis; pronoto brevi, capite parum latiore, ad basim latissimo,

tuberculis parvis remotis ornato, angulis posterioribus vix productis; elytris perbrevibus, omnino quadratis, depressis, capite atque pronoto nec latioribus, neque longioribus, modice asperatis, apicibus vix rotundatis; abdomine modico, rufo-piceo; pedibus atque antennis sat gracilibus, læte flavis.

This species was found in California by Lieut. T. L. Casey, U. S. E., and is distinguished from others by its small size and quadrate form.

Ptenidium Caseianum, sp. nov.

L. c. 0.75 mm. Angustum, elongatum, modice convexum, sat profunde punctatum, nitidissimum, pilis griseis indutum, nigrum elytrorum apice rufo-piceo; capite magno, punctis sat magnis impresso, nigro, labro rufo-piceo, oculis modicis; pronoto sat parvo, capite latiore, ante basim latissimo, punctis sat magnis remote impresso, foveis basalibus minutis, inconspicuis, margine basali fere recta angulis rotundatis; elytris longis, angustis, capite atque pronoto parum angustioribus atque profundius punctatis, ante media latissimis, apice angusto, rufo-piceo; pedibus læte flavis; antennis atque palpis obscure flavis.

Differs from other species in its long narrow form and especially in sculpture.

Found by Lieut. Casey in California.

Ptenidium attenuatum, sp. nov.

L. c. 0.75 mm. Elongatum, valde angustatum, nitidissimum, obscure castaneum, pilis brevibus flavescens sparse indutum, foveis basalibus pronoti permagnis; capite magno, indistincto punctato, oculis sat prominentibus; pronoto capite longiore atque latiore, ante medium latissimo, indistincte punctato, foveis basalibus permagnis et profundis, angulis posterioribus obtusis; elytris valde angustatis, pronoto haud latioribus, prope humeros latissimis, striis valde remotis minute punctatis, castaneis dimidio apicali flavescens, apice attenuato; pedibus atque antennis longis, flavis.

This species occurs in Italy, and may be known by its long narrow form, very large thoracic foveæ, and otherwise peculiar sculpture.

Ptenidium africanum, sp. nov.

L. c. 0.75 mm. Ovatum, convexum, nitidum, alutaceum, modice punctatum, nigrum, pilis brevibus flavis sparse indutum, foveis basalibus pronoti nullis; capite magno, fere impunctato, oculis haud prominentibus; pronoto magno, prope basim latissimo, alutaceo, fere impunctato, angulis posterioribus obtusis; elytris pro-

noto haud latioribus, ante media latissimis, alutaceis, modico striatim punctatis, apice obtuso, parum dilutiore; pedibus atque antennis læte flavis.

Differs from *Pt. evanescens* in its much smaller size, narrower form, alutaceous surface, and faint sculpture.

Found on Mont Carrée in Algeria by Mr. Lewis.

Ptilium obcecatum, sp. nov.

L. c. 0.75 mm. Elongato-ovale, valde convexum, nitidulum, nigropiceum, pilis pallidis sparsissime indutum, lineis pronoti nullis; capite magno, antice producto, oculis rudimentariis, longe retropositis; pronoto modico, capite parum latiore, ante basim latissimo, tuberculis modicis irregulariter dispositis ornato, angulis posterioribus obtusis; elytris ovalibus, pronoto vix latioribus, leviter asperatis, apicibus rotundatis, dilutioribus; pedibus modicis, piceis; antennis elongatis, gracillimis, piceo-testaceis.

This species is distinguished from all its congeners by its minute, almost rudimentary eyes and very long slender antennæ.

In the collection of Herr E. Reitter, found by Herr Brenske near Taygetus in the Morea.

Ptilium incognitum, sp. nov.

L. c. 1 mm. Elongato-ovatum, nigro-piceum, valde convexum, leviter et confertim tuberculatum, pilis brevibus argenteis sparse indutum, lineis pronoti parallelis; capite parvo, antice elongato, oculis haud prominentibus; pronoto modico, capite parum latiore, pone medium latissimo, basim versus fortiter constricto, lineis tribus parallelis in disco distinctissime impresso, angulis posterioribus prominulis, acutis, anterioribus valde deflexis; elytris ovatis, convexissimis, capite atque pronoto duplo longioribus, multo latioribus, pone media latissimis, ad humeros valde attenuatis, leviter confertimque tuberculatis, atque tuberculis majoribus hinc et illic ornatis, apice obtuse, dilutiore; abdominis pygidio valde obtuso; pedibus longioribus, læte flavis; antennis longis, piceis, ad basim dilutioribus.

This large and very distinct species has, owing to the parallel lines on its thorax, been confounded with *Pt. affine*, Erichs., but, with the exception of the thoracic lines, differs entirely from that species in size, form, colour, and sculpture. It appears to be very rare. I found it in Wicken Fen, Cambridgeshire, but have met with it in only two continental collections; in both of these it was labelled "*Pt. affine*."

Gumley,
December 22, 1888.

XX.—*On some Points in the Anatomy of the Species of Palæechinus (Scouler), M'Coy, and a proposed Classification.* By Prof. P. MARTIN DUNCAN, F.R.S., F.L.S., &c.

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THERE are some very well-preserved specimens of several species of the genus *Palæechinus* (Scouler), M'Coy, in the British Museum, in the Woodwardian Museum, Cambridge, and in the Museum of Practical Geology, Jermyn Street, and their study yields some very definite information upon some important points in their anatomy. Some of the specimens show the dorso-central system nearly perfectly, and others exhibit the ambulacral structures, so that the plates can be drawn and studied; portions of the jaws and teeth remain and, together with the interradial plates, are very interestingly preserved.

The Apical or Dorso-central System and its Variations.

It is evident that there is considerable variability in the construction of the apical system in species of *Palæechinus*. The largest specimen of *Palæechinus sphaericus* at the British Museum has the apical system with five large, tumid, basal plates, which are separate, and with five radial plates, which are placed between the basal plates and form with them a ring around the periproct. There is a circle of small, thick, and somewhat irregularly shaped anal plates immediately within the ring of the periproct. The basal and radial plates are large and tumid.

Another specimen of the same species has the apical system perfect, except in the anal plates. The periproct is pentagonal and is surrounded by a circle of thick, tumid, basal plates; the five radial plates are triangular and are only intercalated between the basal plates on the outside of the system, and they do not form a part of the ring or margin of the peri-

proct. It is very interesting to find this variability of the entrance of the radial plates, which is not uncommon in Mesozoic and recent species of Echinoidea, exemplified in the *Palæechinoidea*.

It was recorded by a late distinguished palæontologist, de Koninck, that the *Palæechini* were without radial plates to their dorso-central systems (Geol. Mag. vol. vii. p. 259, pl. vii. fig. 1). It appears now evident that the specimens studied by that able palæontologist had been subject to crush and irregular pressure, so that the radial plates were either pushed into the test or pressed away. In one of the specimens of *Palæechinus* in the British Museum one half of an ambulacrum was thus disposed of, so that an interradium is placed next to the median suture of an ambulacrum. There is a specimen of a *Palæechinus* in the Woodwardian Museum showing small radial plates partly crushed inwards.

The apical system of the largest specimen of *Palæechinus sphaericus* in the British Museum has great resemblance to the system of *P. elegans* described and drawn by Baily, Geol. Mag. vol. ii. p. 44, and reproduced by R. Etheridge, Jun., in Quart. Journ. Geol. Soc. 1874, vol. xxx. pl. xxiv. In fact the differences are the apparent flatness of the system in Baily's figure and the presence of the perforations, which are obliterated in the British-Museum specimens.

It is evident that the generic diagnosis of *Palæechinus* must refer to the presence of five radial plates, which may or may not be perfectly intercalated between the corresponding basal plates. The specific diagnosis of *P. sphaericus* must be altered from that of de Koninck and Lovén ('Études,' p. 41), for the absence of radial plates is accidental.

The small, thick, irregularly shaped anal plates of *P. sphaericus* in no way resemble those of the Saleniidæ, nor in fact do those of *P. elegans*, as figured by Baily; there is no appearance of a "sur-anal."

The Anatomy of the Ambulacral Plates.

The specimens of several species of *Palæechinus* in the Museum of Practical Geology, in the Woodwardian Museum, and in the British Museum show the construction of the ambulacra perfectly. The following observations were made.

I. There are two vertical rows of pairs of pores throughout each side of an ambulacrum; the pores of the pairs are nearly or quite horizontal, but may be oblique, are separated by a thin convex septum placed vertically or nearly so, and there is no peripodium; the adoral pore of a pair is not near the adoral

suture of its plate on the outside of the test, and is equally remote from it when seen from within the test. The pairs alternate, are in a slightly sunken zone, and the interporiferous areas are rather wide and more or less convex. This arrangement of the pairs is seen in *P. gigas*, *P. sphaericus*, *P. intermedius*, *P. ellipticus*, and *P. Phillipsiæ*.

II. The plates of the ambulacra are very numerous and variable in shape in the same ambulacrum; in shape and arrangement they differ in the species, but there may be a great sameness in the plates of *P. gigas*. Simple primary plates, one large at the ambulacro-interradial end, and the next small there or blocked out, with or without alternate demi-plates, are the commonest, and true composite plates are very rare in all species and absolutely absent in some. A succession of similar primary plates, the pairs of pores being uniserial, is not observed in the species noticed above.

III. The ambulacral plates are low and yet very thick, and when in place present a zigzag at their interradian edges—there being a vertical series of alternate salient and reentering angles there, the one being at the edge of the plates which are perforated by the pairs of pores of the outer vertical row, and the other corresponding more or less to the plate of the inner row of pairs of pores. The projection of the salient angles towards the interradia is very decided as a rule, and may be more or less rounded (figs. I., II., V., VIII., X.).

This ambulacro-interradial line of suturing of course brings the zigzag of the ambulacral edge in contact with the ambulacral edge of the interradium, and this will be found to be a zigzag, and its reentering angles fit the salient angles of the ambulacral edge. Isolated plates may be seen showing these projections and depressions, and it is evident that the plates of the test were readily separable at this suture, for the ambulacra are often displaced, the ambulacral plates of the interradia being more prominent or the reverse than the ambulacra. When the opposed edges of the two series of plates are in their normal condition, the more or less rounded outer angles of the ambulacral plates are very visible and never assume the simple character figured by M'Coy and reproduced by R. Etheridge (Quart. Journ. Geol. Soc. vol. xxx. pl. xxiv. fig. 2, from M'Coy, Synop. Carb. Foss. Irel. pl. xxiv.). There is no overlap of the interradia over the ambulacra, and the test was as rigid there as in an *Echinus* and not very unlike one in the suturing.

The Ambulacra of Palæechinus gigas (fig. I., p. 206).—These

are long and narrow, and are composed of a vast number of small, low, thick plates. The vertical rows of pairs of pores are in slightly depressed poriferous zones, the interporiferous areas are slightly convex and broad, the sutures between the plates are usually distinct. The surface of a plate of some size is granular around the pair of pores and has three horizontal rows of very small, distant, primary tubercles, which have a flat circular scrobicule and a small boss; granules are also present; the minute ornamentation contrasts with the dimensions of the test. The ambulacral plates are of two kinds (*a* and *b*), each being perforated by a pair of pores near its outer end. One kind of plate (*a*) is low, broad, thick, occupies much of the interporiferous surface of the ambulacrum, and is perforated by a pair of pores not very close to the ambulacro-interradial suture; it is a plate of the inner vertical series of pairs of pores. These plates may be perfect or imperfect primaries. In the first instance (fig. I., *a*) a very low and often almost linear part is seen external to the pair of pores and reaching the reentering angle of the ambulacro-interradial suture. The low part is so small that it permits the large-ended plates of the outer vertical series of pairs of pores (*b*) to come nearly close together. In the other instance the outer linear projection of the plate has been lost (fig. I., *a'*), and the plate ends in a point, which does not reach the edge of the ambulacro-interradial suture; the linear part has been jammed out by the increasing growth of the plates of the outer series. (Fig. I., *a*, perfect primary, *a'*, a primary blocked out from the ambulacro-interradial suture.) Both kinds of plates form geometrical figures at the median suture of the ambulacrum, are highest there, and their horizontal or transverse sutures are distinct for one third or one half of the distance from the median line outwards. The existence of the second kind of ambulacral plate (fig. I., *b*), which carries a pair of pores of the outer vertical series, prevents the transverse sutural line being continuous to the ambulacro-interradial edge.

The second kind of ambulacral plate (fig. I., *b*) is perforated by an outer pair of pores, and its outer edge forms the salient angle at the suture already noticed. The plates of this kind, although large externally, are smaller than the others, are placed alternately with them, are narrow internally, and do not reach the ambulacral median line. They are low, inward-pointed demi-plates with a large outer end, where the pores are. The outer and large ends of these demi-plates are often so close vertically that, as has been already noticed, they occlude the outer process of some primary plates

(a'). It does not appear that this demi-plate and its actinal or abactinal primary ever form a true composite plate. There is no overlap of the ambulacral plates.

Lovén ('Études,' 1874, p. 41) notices *P. gigas*. He observes that the figure given of it by M'Coy (*op. cit.* pl. xxiv. fig. 4 c) shows ambulacral plates each with two pairs of pores; this he properly considered to be erroneous. W. Keeping (Quart. Journ. Geol. Soc. 1876, vol. xxxii. pl. iii. figs. 12, 13) gives M'Coy's figure and a correction. Now, although these drawings show a marked difference from the structures visible in the specimens I have described, still in specimens where obliteration of the sutures has taken place and where the pores are greatly crowded vertically, both of the appearances drawn by M'Coy and Keeping are to be recognized. But they are deceptive, and the truth is explained in weathered parts of the same test. Nevertheless there were no intercalated demi-plates noticed in M'Coy's definition of the genus or species. Lovén places *P. gigas* in a group of *Palæechini* which have the ambulacral plates differing alternately, having the same height at the median suture and one entire (a primary), and the other reduced to a cuneiform demi-plate, its point directed outwards. In the specimens of *P. gigas* in London and Cambridge the demi-plate has its point directed towards the median line, which it does not reach. It will be seen, however, that the structure noticed by Lovén is found in another species, *P. sphaericus*.

Ambulacra of *Palæechinus ellipticus* (fig. VIII.) present ambulacral plates somewhat similar to those of *P. gigas*, and the pairs of pores are biserial on each side of an ambulacrum. Hence there is an error in the specific diagnosis and drawing of M'Coy (in Foss. Mount. Limestone Ireland, 1842, pl. xxiv. fig. 3; *P. gigas* is incorrectly drawn, fig. 4).

The specimen in the Museum of Practical Geology (XIII | $\frac{2}{30}$) shows very convex interporiferous areas. The plates with the outer pairs of pores are small demi-plates; the primary plates with the inner rows of pairs of pores are narrowed between the demi-plates and usually do not reach the ambulacro-interradial suture (fig. VIII.).

Ambulacra of *Palæechinus sphaericus* (figs. II.—VII.).—There are two specimens of this species, one a crushed mass and the other more or less prolately spheroidal, in the British Museum which show the structure of the ambulacra very well. The arrangement of the pores in two vertical rows of

pairs is the same as in *P. gigas*, but the shape and the nature of the plates differ. The commonest arrangement of the plates is seen at a little distance from the apical system (fig. II.). The pores of the pairs, which are in two vertical series and alternate, are large and often rather broad; they are separated by a septum, as in the other species. As in *P. gigas*, the pair of pores of the outer vertical row (*b*) are in plates which form the salient angle of the zigzag at the ambulacral edge; and the pair of pores of the inner row (*a*) are in relation with the recentering angles. The plates are of two principal kinds, and the first to be noticed are those which are perforated by the inner pairs of pores. These plates are either perfect, low, broad primaries, highest at the ambulacral median line (*a*), having much transverse suture, and narrowing and becoming pointed at the ambulacro-interradial suture, or imperfect primaries, with their outer part, near the ambulacro-interradial edge, reduced to a point which does not reach outwards to the outward edge (*a'*). Both of these plates are usually high at the median line and have a single horizontal row of minute scrobiculate tubercles, with a boss and some granules (fig. II., *a*, *a'*).

The other principal kind of plate (fig. II., *b*) is a low primary, as broad as those just described, but slightly lower at the median line and larger externally, where there is a large pair of pores of the outer vertical series. The plate is expanded around the pores and highest there. The ornamentation is the same as that of the other plates. It will be observed that this arrangement is different from that of *P. gigas* and that both plates are primaries, there being no demi-plate. Nearer the apical system the size of the pair of pores is not sufficient to produce much enlargement of the outer part of the plate, which has an outer pair of pores (fig. III., *b*). But the slight increase of height is readily seen, and it has the effect of diminishing the size of the next plate (*a*), with an inner pair of pores (fig. III.). It certainly appears, when the sutures of the plates are invisible, as if there were two pairs of pores to a plate, as M^cCoy drew and Keeping criticized.

One composite plate is seen in a specimen near the apical system and the components are primaries; the inner edge of the combined plates forms an angle, and the larger plate is with a large outer and inner part (fig. IV., *b*), while the smaller plate (*a*) is low at both ends and has a suture curved adorally.

A common arrangement of the plates of the ambulacra (fig. V.) is as follows:—

A plate (fig. V., *b'*) is large where it is pierced by the pores, and forms a projecting angle at the ambulacral edge;

it is broad, and whilst its height is the same as that of the other plates at the median ambulacral line, it is nipped in, vertically, at its middle in consequence of the shape of the plates above and below it (a^1 and a^2). The first of these (a^1) is a low primary, smallest at the extremities, pierced by an inner pair of pores, and it has a transverse curved adoral edge and also a convex aboral sutural edge to connect it with the primary (b').

The other plate, a primary (a^2), is aboral to the primary b' , is tall at the ambulacral median line, low close to the pair of pores, and externally it is not quite reduced to such a mere point as in the instance of the first component (a^1), which just reaches the ambulacro-interradial edge at a reentering angle. The adoral sutural edge of the plate (a^2) is convex and the aboral edge is straight or slightly concave in the opposite direction. The arrangement of these three unequal primary plates has geometrical outlines neither externally nor at the median ambulacral line, and is repeated in the vertical succession (fig. v., a^1 , b , a).

Amongst the plates of this species are some which are not only characteristic but very suggestive of the reduced and isolated plates of other Palæechinoidea and of the later Echinothuridæ.

A composite plate (fig. vi.) has a small aboral primary a and a large middle primary b ; but the third component is adoral and at the ambulacro-interradial edge, and is a small demi-plate looking like a peripodium without a plate, and it is crushed a little out of place. This demi-plate (a') should be compared with that seen in a doubtful composite plate (fig. vii., a'). It is evident that the crush of growth has enabled the large primary plate (b^2) belonging to the outer vertical row of pores to crowd out, with the assistance of its adoral neighbour (b^1), the primary of the inner row. This has lost all its inner part, has become a demi-plate (a'), and but a trace of the outer portion remains; the rest is like a thick peripodium.

The occurrence of small isolated plates along the lines of transverse sutures, a phenomenon especially Echinothurian in the recent fauna, has therefore a certain explanation. The plates thus placed and small are not additional and intercalated plates, but are the results of growth, crowding, crushing out and in, and atavism of original plates.

It does not appear unreasonable to account for the presence of four vertical rows of ambulacral plates in some Palæechinoidea by an early movement of the plates perforated by the inner row of pairs of pores inwards whilst the growth proceeded.

The thickness of the ambulacral plates of *P. gigas* and *P. sphaericus* is remarkable, and is much greater than their vertical height; there is no overlap of the edges and the test was rigid.

The interrarial plates of the species are very thick and the edges present no evidence of flexibility. The ambulacral rows of plates have their ambulacral edges as zigzags and the angles fit into the corresponding reentering angles of the ambulacral plates. The resemblance to many Mesozoic and recent species of regular Echinoidea is exact in this respect.

Ambulacra of Palæechinus intermedius, W. Keeping (Quart. Journ. Geol. Soc. vol. xxxii. p. 37, pl. iii. figs. 9-11).—There are specimens of this species in the Woodwardian Museum and also in the Museum of Practical Geology. The late Mr. W. Keeping doubted whether the species could be placed with *Palæechinus*; but he was misled, apparently, by the diagnosis of M^cCoy, especially of the part relating to the construction of the poriferous zones. The ambulacra of *P. intermedius* have biserial pairs of pores and the plates are very numerous, low, broad, and thick (figs. IX. and X.). The plates are all primaries and are in regular vertical succession, so that there is a single vertical row of them on each side of the median ambulacral suture. But the plates are different in shape in the same vertical row, although not to the amount shown in *P. gigas*. The plates with the outer pairs of pores are largest at their outer part, which forms the salient angle of the ambulacral edge of the ambulacro-interrarial suture, and they reach the median ambulacral line, being lower there than near the part which bears the pair of pores. The plates which bear the inner series of pairs of pores are narrow externally and may or may not reach the interrarial suture, and if they do so it is by a pointed angle. They are low, broad, and are often higher at the ambulacral median line than the other primaries with the outer series of pairs of pores. Fig. IX. from a specimen in the Museum of Practical Geology and fig. X. from the Woodwardian specimen.

Ambulacra of Palæechinus Phillipsiæ, Forbes.—*Palæechinus Phillipsiæ*, Forbes, is to be seen in the form of models which have been made by running in a melted substance into the hollow fossil. This substance, when solid, shows the inside of part of the test, and therefore the ambulacral and other plates are represented on the model so far as their inner surfaces are concerned.

The model at the Museum of Practical Geology shows a double row of pairs of pores here and there, in an ambulacrum, but the suturing of the plates is not visible. Nevertheless the plates were evidently arranged after the system of the primaries of *P. sphaericus* (fig. II.). Forbes gives a diagram of the plates and the pairs; but the inner pair of pores is placed too close to the median line of the ambulacrum and its plate is too much blocked out from the ambulacro-interradial suture. (Compare Forbes, 1848, Mem. Geol. Survey United Kingdom, vol. ii. pt. i. p. 384, pl. xxix. fig. 1, and the fig. II. of this communication.)

The Grouping of the Species.—It will have been observed that no less than five species of *Palæechinus* present two vertical rows of pairs of pores on each side of the ambulacra. The species group themselves into two divisions. In one, containing *P. gigas* and *P. ellipticus*, the outer pairs of pores of the vertical rows are in demi-plates, and in the other division, containing *P. sphaericus*, *P. intermedius*, and *P. Phillipsiæ*, the plates of both sets of pairs of pores are primaries, some being blocked out from the ambulacro-interradial sutures. Very rarely there is some crowding and union of plates to form compound ones, as in *P. sphaericus*.

It is very remarkable how distinct some of the plates are from their neighbours, and it is evident that their great thickness would keep them from overlapping. It would seem at first sight as if there had always been a space between the edges of the plates; but in the Woodwardian specimens and in some elsewhere the plates are often so close that there is no vestige of a sutural line between them. Hence the drawings given by M'Coy and W. Keeping, which have been noticed.

The Characters of Palæechinus elegans and P. quadriserialis.—The question arises, Where are *Palæechinus elegans*, M'Coy, *P. quadriserialis*, J. Wright (Journ. R. Geol. Soc. Irel. vol. i. p. 62, pl. iii.), and a small-plated *Palæechinus* in the Woodwardian Collection, which does not present the characters of any of the five species mentioned above, to be placed?

In a classification of recent or Mesozoic Echinoidea no one would place species with a single vertical row of pores on each side of an ambulacrum in the same genus as species presenting two vertical series of pairs on each side of an ambulacrum, the plates differing markedly in their shape and arrangement also. *Cidaris* is separated on these lines from *Diplocidaris*. Now *P. elegans* has all its ambulacral plates

and primaries subequal, and there is no crowding to form demi-plates or to crush out parts of plates from the interradial sutures. The plates are Cidaridean in their simplicity and each has a pair of pores, so that there is one vertical series on each side of an ambulacrum. This is the case with *P. quadriserialis* and with the small *Palæechinus* in the Woodwardian Museum. It must be admitted that the alliance is close, but these species cannot enter the same genus as *P. gigas* for instance. Unfortunately M'Coy was not impressed with the value of the ambulacral characters, and placed *P. gigas*, *P. elegans*, *P. ellipticus*, *P. sphaericus* and another as types of his genus *Palæechinus* (M'Coy, in Griffith, Foss. Carb. Limest. Irel. 1842, p. 171, see pl. xxiv), every ambulacrum being wrongly figured by his artist. W. Keeping was clearly impressed with the want of homogeneity in the genus; and when he met with the specimen in the Woodwardian Museum, which has a small test with small plates and straight, single, vertical rows of pairs of pores, one series of pairs only being found upon each side of an ambulacrum, he defined a new genus *Rhoechinus* (*op. cit.* p. 37). Really this genus, with a very slight modification, will embrace the forms of *Palæechinus* with uniserial pairs of pores.

From our present knowledge, if *Palæechinus* is to remain as a genus—and it ought to do so, for M'Coy's work claims great respect—it must be as *Palæechinus*, M'Coy (pars), and relate to species with a double vertical row of pairs of pores, such as *P. gigas* and *P. sphaericus*. *Rhoechinus*, Keeping, slightly modified, will then contain *P. elegans*, possibly *P. quadriserialis*, and certainly the little form in the Woodwardian Museum.

Synonymy.

Genus PALÆECHINUS, M'Coy, pars.

P. gigas, *P. sphaericus*, *P. ellipticus*, *P. intermedius*,
P. Phillipsiæ.

Genus RHOECHINUS, Keeping.

R. irregularis, Keeping; *R. elegans*, M'Coy, sp.; *R. quadriserialis*, J. Wright, sp.; *R. sp.* (in the Woodwardian Museum, named a *Palæechinus*).

The two North-American species, which I have not seen,
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appear to belong to *Palæechinus* as now limited. *P. Konigii*, M' Coy, is insufficiently diagnosed, the type being fragmentary.

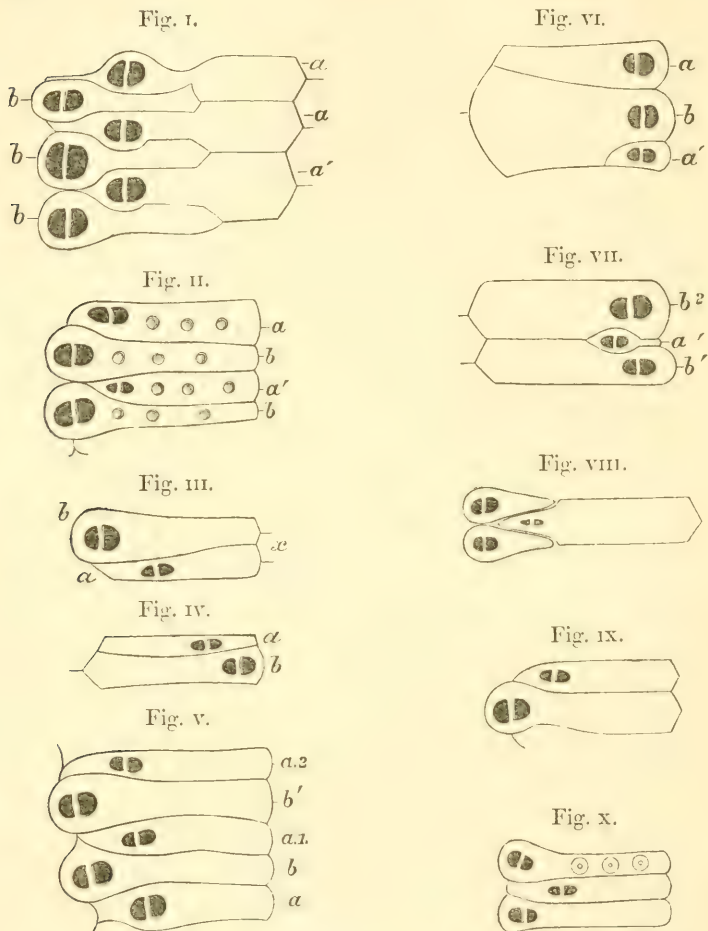


Fig. I.—One side of part of an ambulacrum of *Palæechinus gigas*, magn.

Figs. II.-VII.—Plates of part of one side of ambulacra of *P. sphaericus*, magn.

Fig. VIII.—Two demi-plates and a blocked-out primary of *P. ellipticus*, magn.

Figs. IX., X.—Parts of one side of an ambulacrum of *P. intermedius*, magn.

The obliquity of the pores of the pairs is sometimes not with the adoral pore directed more or less actinally; this unusual condition is represented in figs. II., V., VI., and IX.

XXI.—On a new *Athorybia*. By J. WALTER FEWKES.

[Plate VII.]

THE genus *Athorybia* is remarkable among Physophores in that the stem is very short, the nectocalyces are absent, and the appendages appear to arise about the base of the float. Its whole anatomy shows embryonic features, since the young of several other genera of Siphonophores pass through a stage in which they have what may be called an *Athorybia*-stage. *Athorybia* is, in point of fact, a genus which, while it has embryonic likenesses, has become sexually mature, although it is ordinarily regarded as an adult. Whether or not it ever passes out of this stage into some other form no one has yet been able to discover.

From the coast of Florida we have a genus allied to *Anthophysa*, to which I have given the name of *Diplorybia*, on account of the existence of two kinds of tentacular knobs*.

The waters of California, so rich in genera of Medusæ, have not hitherto yielded a single species of *Athorybia*. The writer is able to add to the list of Medusæ found in the waters of California a new *Athorybia* for which he suggests the name *A. californica*.

Athorybia californica, sp. nov.

Float.—The float is large, conspicuous, and carried upright as the animal swims in the water. Colour pink, with apical zone dark crimson to brown.

Nectocalyces.—No nectocalyces or nectostem present.

Hydrophyllia.—The hydrophyllia arise from an enlargement at the base of the float. They are leaf-like, transparent, gelatinous, placed in a ring about the lower region of the float, above the polypites, tasters, and tentacles. They are ordinarily carried extended at right angles to the axis of the float and are capable of a free flapping movement, by which the animal may be propelled through the water.

Each hydrophyllium is thin, indented on either side at a point situated about half its length by a well-marked indentation or notch. The distal extremity is rounded and pointed, the proximal being united to the body by a short and incon-

* I formerly called this Floridan Physophore, discovered at Key West, Florida, a new species of *Athorybia* (*A. formosa*). Hæckel refers it to *Anthophysa*; but it seems to me that it should receive a new generic name, and I have elsewhere suggested the name *Diplorybia*.

spicuous peduncle. The outer surface of each hydrophyllium is crossed by longitudinal rows of nematocysts, which are easily seen.

Each hydrophyllium is penetrated by a tube, which communicates with the cavity of the body below the float. This tube ends cæcally at the distal extremity of the hydrophyllium, and is simple and unbranched.

Tasters.—Below the circle of hydrophyllia there arise from the body of the *Athorybia* numerous long, highly flexible, flask-shaped bodies, which closely resemble the so-called "tasters" of Physophores. They also recall the flexible bodies which are found appended to the nectostem of *Apolemia* *.

They can be gracefully moved back and forth and can be extended outward between the hydrophyllia, so that their extremities often reach far beyond these organs. Filamentous appendages of the tasters were not noticed. The tasters have a pinkish colour.

Polypites.—A single, large, well-developed, and several immature polypites were noticed. The large, fully developed polypite, *p*, opens directly into the cavity of the body below the float, of which it appeared to be a continuation. This polypite is flask-shaped, with an opening or mouth at the distal end which extends far beyond the hydrophyllia. The lips of the mouth are often expanded, imparting a trumpet-shape to this region of the polypite. This polypite is more opaque than the others, although partially digested food was observed through its outer body-walls. The other polypites are immature, closely resembling in form the tasters, and in many of them an open mouth was observed.

Three well-developed tentacles are figured in my sketch (Pl. VII. fig. 1). The tentacle, *t*, which arises from the basal region of the largest polypite is somewhat more conspicuous than the others. The tentacles were observed to have a single kind of tentacular knob (fig. 2), which, while it differs considerably from either kind of tentacular knob found in *Diplorybia formosa*, resembles somewhat those of *Athorybia rosacca*, Köll. Each tentacular knob has a single unbranched peduncle, *pd*, which hangs at intervals from the tentacle itself.

The structure of the tentacular knob of *A. californica* is peculiar †. The base of the knob by which it is joined to

* For these bodies in *Apolemia* the name nectotasters is suggested.

† The tentacular knobs of *A. californica* differ very greatly from those of any known species of *Athorybia*. The character of the tentacular knobs is a very good feature by which to distinguish different species of Physophoran genera.

the peduncle forms a sacculus. The sacculus, *s*, ordinarily forming a bell-shaped covering enveloping a structure known as the involucre, is in our new Californian *Athorybia* very much modified and reduced in size. It is a globular or hemispherical enlargement which shows the "spongy" cellular walls which have been described in the knobs of the genus *Rhizophysa*. On one side this hemispherical sacculus is enlarged or extended into a conical projection, recalling the beak-like processes of certain of the knobs of the genus *Rhizophysa*. This portion of the knob likewise shows the characteristic "spongy" cellular contents. The apex is tipped by a conspicuous pigment-spot.

The involucre, *i*, takes a single turn, and is seldom covered by the sacculus. It is densely pigmented and apparently formed of well-developed nematocysts.

There is a single terminal median vesicle, *tv*, and two terminal filaments, *tf*. These structures have a close likeness to the same bodies in other Physophores, and seem more like immature than fully developed knobs.

The size of the whole body, including its length without tentacles from the apex of the float to the open end of the polypite, is one eighth of an inch. The diameter from one tip of the expanded hydrophyllia to that of the opposite has the same or approximately the same measurement. The animal was taken in the Santa Barbara Channel, off the coast of Southern California.

The question naturally arises, Is not this the young of some long-stemmed Physophore, like *Agalma*, as yet unrecorded from the Californian waters of the Pacific? There is nothing to prevent our answering this question in the affirmative, since we know that several genera pass through a similar form in the course of their development*. Still the animal which we have represented in our Plate, even if a larval form of some long-stemmed Physophore, is in certain respects different from any larva which has yet been described.

The sexual bodies lie around the bases of the polypites, but they are very little developed, a fact which certainly looks as if the animal is a larval form. Still, even if they were well developed, that fact alone does not indicate that the animal is mature, for among the Physophores examples might be instanced in which a genus matures its sexual products before its adult form is reached.

* In my studies on the Pacific coast I have never taken a long-stemmed Physophore of any kind, and I am not aware that others have recorded them from the locality where my studies were made.

EXPLANATION OF PLATE VII.

Fig. 1. Athorybia californica. A view from the side, showing the hydrophyllia more or less expanded; tentacles and polypite extended. Drawn from a living specimen.

Fig. 2. Single tentacular knob very much magnified.

Lettering.

| | |
|---|-------------------------------|
| <i>a.</i> Apex of sacculus. | <i>s.</i> Sacculus. |
| <i>f.</i> Float. | <i>t.</i> Tentacle. |
| <i>hc.</i> Hydrophyllium. | <i>tf.</i> Terminal filament. |
| <i>i.</i> Involucrum. | <i>tk.</i> Tentacular knob. |
| <i>p.</i> Polypite. | <i>ts.</i> Taster. |
| <i>pd.</i> Peduncle of the tentacular knob. | <i>tv.</i> Terminal vesicle. |

Cambridge, U. S. A.,
November, 1888.

XXII.—*Further Observations on the Foraminiferal Genus Orbitoides of d'Orbigny.* By H. J. CARTER, F.R.S. &c.

SINCE my observations on the genus *Orbitoides* of d'Orbigny were published ('Annals,' 1888, vol. ii. p. 439) I have received several type specimens of *Orbitoides media* from the Upper Chalk in the south-west of France, which, being the same in specific characters as those from the Chalk of Maestricht that I had already described (*op. et loc. cit.* p. 445), have enabled me personally to compare the two, which previously I had only been able to effect by quoting M. le Vicomte d'Archiac's description of this fossil under the name of "*Orbitolites media*" (*ib.* p. 446).

For this welcome present I am indebted to my kind friend Mons. G. Berthelin, formerly of Nantes, now residing in Paris, whose valuable contributions to the knowledge of Foraminifera are well known, and who, on learning from the paper to which I have alluded that I had no specimens of "*Orbitoides media*" from France to compare with d'Orbigny's illustrations, immediately sent me twenty, labelled "*Orbitoides media*, d'Archiac, sp. Dordonien (Craie supér.), Meschers (Charente-Inf.), près Royan." These appear from their smallness, varying from 5-48ths to 6-24ths inch in horizontal diameter, to belong to the lesser size mentioned by d'Archiac as probably being young forms of his larger one rather than a different species, which measured "50 millim." in diameter (*op. et loc. cit.*).

Be this as it may, these specimens are sufficient to show after careful examination not only that they are identical in their specific nature with the specimens from Maestricht, but that they entirely accord with d'Orbigny's illustrations in his 'Cours Élément. de Paléont. et de Géologie' (vol. i. p. 193), being therefore genuine varieties of, if not identical with my *Orbitolites Mantelli* ('Annals,' *l. c.* p. 442). Thus I observe that the vertical papillary eminence of the crust on *each* side of the central plane, although only seen on one side in the specimens from Maestricht, is perfectly developed on both sides in those from the south-west of France, and therefore identical with d'Orbigny's "Profil" ('Cours,' *l. c.*); also that the sinuous lines on the surface radiating from this eminence to the circumference in d'Orbigny's adjoining representation are equally identical. These lines are intended for ridges of shell-substance continuous with that forming the central eminence, and radiating at first singly from this point become so multiplied by subdivision afterwards (that is as they approach the circumference) as to spread all over the disk. Originally they are derived from the union of granulations which more particularly characterize the specimens from Maestricht, where they may be seen to be the outer ends of the "conical columns" to which I have alluded in my description of this form ('Annals,' *l. c.* p. 445).

Still this does not interfere with what I have endeavoured to point out, viz. that the cells of the central plane of d'Orbigny's *Orbitoides media* present in the horizontal section a *spheroidal* form, and that those of his *Orbitoides papyracea* ('Cours,' vol. ii. p. 732) are *rectangular*—a distinction which it is desirable to bear in mind, as at present the term "*Orbitoides*" is indiscriminately used for both kinds, so that it is not known when this term is mentioned which kind is meant, a circumstance that the following paragraph will show to be likely to lead to confusion both palæontologically and geologically.

At present we know that *Orbitolites Mantelli* has been found in the midst of a bed of *Nummulites sublaevigata* in Sind, and *Orbitoides dispanza* in one of *N. exponens* at Lukput, in Cutch, in confirmation of which I now possess specimens. Hence it is possible that all three may exist somewhere together. But there are no *Nummulites* with *Orbitolites Mantelli* in the Claiborne beds of Alabama, none that I could see in the bed of the cliff at Takah, on the south-east coast of Arabia, nor in the specimens from the bed at Nal, in Jhalawan, nor in those from that of the bank of the river Irrawadi discovered by Mr. Theobald—circumstances which

a more extended acquaintance with the strata of the Eocene series may explain.

With the distinction to which I have alluded, it became necessary to establish a separate division for the discoid Foraminifera typified by *Orbitolites Mantelli*, and this, which I proposed in 1861 ('Annals,' vol. viii. p. 328), was done by Gümbel seven years afterwards under the name of "*Lepidocyclina*" ('Beiträge zur Foraminiferen-Fauna der nordalpinen Eocäengebilde,' München, 1868). In short Gümbel in this work has divided d'Orbigny's "*Orbitoides*" into five subgenera, reserving the fifth for the kind typified by my *Orbitolites Mantelli*, and devoting the rest to that typified by *Orbitoides papyracea*.

Of course the subgeneric name "*Lepidocyclina*" would thus take the place of "*Orbitolites*;" but if it can be reasonably inferred that *Orbitolites Mantelli* is but an evolutionary development of Lamarck's genus "*Orbitolites*" and evolutionary doctrine is to have influence on nomenclature, then the propriety of introducing a new name for anything coming from the latter seems undesirable. It was this that influenced both Faujas de St.-Fond and d'Archiac in using the generic term "*Orbitolites*" for this fossil. Hence the term "*Orbitoides*" might be retained for the kind typified by *Orbitoides papyracea*, and that of *Orbitolites* for those typified by *Orbitolites Mantelli*, while the whole, together with *Nummulites*, might be included, as proposed by Carpenter, in the family "*Nummulinida*" ('Introduction to the Study of Foraminifera,' p. xiv, 1862).

I have already adduced reasons based on evolutionary views for using the term *Orbitolites Mantelli* ('Annals,' 1868, vol. ii. p. 442), to which I might add that the papillary eminence on *Orbitoides media*, d'Orbigny, is almost always represented on *Orbitolites marginalis*, Lam. (that is the recent species), by an accumulation of shell-substance on the centre of the disk possessing an irregularly stellate form, whose rays extend for a short distance towards the circumference, and that, although the cells in most instances do not present the foramina on the surface which are observed in the cell-divisions of *Orbitoides media*, d'Orb., in a horizontal section of the crust, yet in some from the Red Sea (Suez) in my cabinet they are unmistakably present in by far the greater number of cells, although in their midst are to be seen some which do not possess them. Why they should be so generally absent in most specimens may be accounted for by the free communication which exists between the interior and exterior of the organism through the numerous apertures on

the margin, the cells (stolonigerous buds), after their first development, breaking into each other so generally that the whole is thus resolved into a cancellated structure (calcareous skeleton) filled with continuous sarcodæ, which issues into the circumambient medium by the way mentioned, as in such-like Foraminifera. Hence this structure in the central plane of *Orbitolites Mantelli*.

Dr. Carpenter, in his admirable "Monograph of the Genus *Orbitolites*" (Phil. Trans. 1856, p. 196, pl. vi. fig. 5), denies the presence of holes in the "shelly substance of the calcareous disks" of *Orbitolites*, but adds that the "punctated marking" here "may be regarded as the rudiments of those minute closely-set apertures which in many Foraminifera give passage to pseudopodial extensions of the sarcodæ." Whether this is the case or not I cannot say; but where the holes in the cells are manifest they are situated respectively on little tubercles as in other Foraminifera.

The holes seen in the cell-divisions of *Orbitoides media*, d'Orb., in a mounted microscopic horizontal section of the crust are merely transverse sections of the minute tubuli which extend perpendicularly from one cell to another; and even these are not visible on the surface of *Orbitolites Mantelli* from Alabama, where the cellular structure is finally covered in by a thin film of ?imperforate homogeneous shell-substance. While in the fossilized Orbitolite from the neighbourhood of Jarrak, in Lower Sind, &c., which I have designated "*pedunculata*" ('Annals,' 1861, vol. viii. p. 463, and delineated in that of 1853, vol. ii. pl. vii. figs. 43-45), the peduncle or papillary eminence is formed of shell-substance, from which sinuous ridges are extended to the circumference in the same way as that represented by d'Orbigny in his illustrations of *Orbitoides media* (op. et loc. cit.). I have already alluded to this structure in the 'Annals' of 1861 (l. c.).

So that altogether, part for part, we have the same structures in *Orbitolites media* as in *Orbitolites marginalis*, saving the "crust," and hence the reason for retaining the term "*Orbitolites*" in generic distinction.

Let us now, in conclusion, direct our attention *more particularly* than I have hitherto done to the structure of this "crust," for, looking at it in the vertical section, it is seen to be composed of columns of vertically compressed cells, which are arranged more or less perpendicularly according to their position on each side of the central plane, in such a manner as to lead to the inference that they are a direct prolongation vertically of the spheroidal ones whose regular arrangement in the central plane, when viewed horizontally, gives rise to

the characteristic engine-turned pattern to which I have alluded, and that any horizontal section through any part of this crust would present this pattern. But this is not the case, inasmuch as the thinnest horizontal section beyond the central plane shows that horizontally these compressed cells are not only very variable in size, but present the utmost irregularity in outline that can be conceived, so that it becomes impossible to trace any *direct* communication between any of them and those of the central plane respectively; while the nearer the columns approach the surface the more these cells (although they intercommunicate with each other throughout by the "minute tubuli" to which I have alluded) become approximated, till at last, in the Alabama species, they are covered in by the smooth homogeneous layer of shell-substance also above mentioned. Hence, like most of the specimens of *Orbitolites marginalis*, the only means of communication externally in *Orbitolites Mantelli* was through the apertures in the margin, the "central plane."

That varieties of the kind typified by *Orbitolites Mantelli* will be hereafter found I have no doubt; and Gümbel has already added two under his subgenus "*Lepidocyclus*," viz. "*L. dilatata*" and "*L. burdigalensis*" (*op. et loc. cit.*).

But that "*Orbitolites*" of Lamarek should be used as the generic name for the type of Morton's *Nummulites Mantelli* of the Claiborne beds in Alabama (as I first proposed) instead of "*Lepidocyclus*" seems to me, on the grounds that I have stated, to be most desirable; while as regards *priority* in nomenclature we find that as far back as 1799 Faujas de Saint-Fond (in his *Nat. Hist. de la Montagne de Saint Pierre de Maestricht*) stated in explanation of his "fig. 4" respecting *Orbitoides media*, d'Orb., that "Cette numismale n'étant pas formée par des cloisons transversales, rentrerait, d'après Lamarek, dans ses *Orbitolites*."

XXIII.—*The Siphonophora of the Canary Islands.*

By Prof. CARL CHUN *.

DURING my residence in Orotava I directed my attention chiefly to the study of the Canarian Siphonophora. I succeeded in discovering, besides the Canarian forms described

* Translated from the 'Sitzungsberichte der königl. preuss. Akademie der Wissenschaften,' 1888, no. xlv. pp. 1141-1173. This is the first section of a "Report upon a Journey to the Canary Islands performed in the winter of 1887-88," and is preceded by a short statement of the cir-

by Hæckel, a considerable number of new species, some of which are not without interest, partly on account of their peculiarity of structure, partly because they represent intermediate forms uniting groups hitherto apparently isolated.

During the autumn months up to the beginning of January the pelagic fauna, especially in Siphonophora, was remarkably poor. Nevertheless the numerous Eudoxiæ and the young stages of Physophoridæ furnished me with abundant material for work, which enabled me to ascertain the Eudoxiæ belonging to all the observed Calycophoridæ and to advance the knowledge of the postembryonal development of the Physophoridæ. It was only from January onwards that the adult Physophoridæ appeared, and with them magnificent new Calycophoridæ, which exceeded in beauty and delicacy all the forms known to me.

Although it does not seem to me advisable to discuss the theories as to the organization of the Siphonophora within the limits of a brief report, I am led, with reference to the principles which guided me in the establishment of the system of the Siphonophora, to enter upon certain views which Hæckel has put forward in his lately published "*System der Siphonophoren auf phylogenetischer Grundlage*"*, especially so far as they are in opposition to the opinions maintained by me.

In the primary larva of the Siphonophora Hæckel sees a simple Medusan persona, which occurs in the form of a *Siphonula* and a *Disconula*. The latter is octoradiæ in structure and becomes subsequently developed into the *Porpita* and *Velella*; while the bilaterally symmetrical *Siphonula* furnishes the starting-point for all the other Siphonophora. In accordance with this Hæckel divides the Siphonophora into two legions, the Disconanthæ and the Siphonanthæ.

In the first place as regards the division of the Siphonophora into two subclasses, of which the one includes the *Velella* and *Porpita* hitherto characterized as Chondrophoridæ or Velellidæ, and the other the whole of the Calycophoridæ and most of the Physophoridæ, I must maintain

cumstances under which the journey was undertaken by the aid of the Academy of Sciences.

The author says:—"As I expected that the persistent north-east trade-wind would bring me material in abundance, I resolved to take up my abode on the north coast of one of the islands, and finally selected for this purpose the Puerto de la Orotava, where I found accommodation thoroughly suited to my purposes in the Fonda de la Marina, situated immediately upon the harbour, and also, after the inevitable first difficulties, suitable boats and fishermen."

* '*Jenaische Zeitschrift*,' Bd. xxii. (1888).

that Hæckel founds his speculations upon two larval forms of very different morphological value. The radiate *Disconula* represents a much altered larva, which was certainly preceded by a bilateral *Siphonula*-stage. Unfortunately we are still unacquainted with the embryonic development of the *Vellele* and *Porpita*; but I have every reason to think that the younger stages closely approach the youngest larval stages of *Physalia* in structure. Young *Rattaria* observed by me which still possess a simple unchambered pneumatophore show four tentacles, which are bilaterally arranged on one side, or, more accurately, present with one large tentacle three smaller ones asymmetrically distributed. This stage was certainly preceded by a true bilateral *Siphonula* with the rudiment of the pneumatophore, a single tentacle, and the stomachal sac. This stage, which certainly has not yet been observed, must be paralleled with the *Siphonula*; but then one would hesitate *à priori* to recognize a fundamental distinction between "*Siphonanthæ*" and "*Disconanthæ*," and to give expression to this condition by seeking a relationship for the *Disconanthæ* with the *Trachomedusæ* and for the *Siphonanthæ* with the *Anthomedusæ*.

In accordance with previous naturalists I see in the *Vellellidæ* true *Physophoridae*, which certainly in their adaptation to a passive movement by action of the wind show very plainly the transformations already stamped upon the *Disconula*. I have repeatedly referred to these adaptations and need only indicate here that I regard as an adaptation to the floating mode of life in the deep sea, *i. e.* at the surface, as a later acquisition, and consequently as an organ *sui generis*, the mantle which was interpreted by Hæckel, in agreement with Metschnikoff, as a *Medusan umbrella*. This limb or mantle, circular in the *Porpita*, oval in the clinoradially constructed *Vellella*, commences in the youngest larvæ as a narrow fold around the still unchambered pneumatophore, and is certainly deficient in the *Siphonula*-stage of the *Vellellidæ* as postulated by me. It originates therefore in the same way as the principal muscular border of the sail in a *Rattaria*. If we were to homologize this mantle with an umbrella we should obtain a *Medusa* which presented upon its exumbrella a richly developed vascular reticulation and a powerful coat of epithelial muscular cells—structural characters which we only meet with in the subumbrella.

There are also some of Hæckel's special interpretations of the structure of the *Vellellidæ* with which I cannot agree. Thus he regards the cetodermal parenchyma placed between the hepatic tubes as a gas-gland, which secretes the air into

the inferior open ends of the tracheæ, from which it afterwards passes into the chambers to be discharged outwards through the stigmata. In opposition to this we find that the cushion of tissue in question is quite different in its histological structure from the secondary ectoderm, which, as I have demonstrated*, has the function of a gas-gland, and, further, that the tracheæ which surround the polypes for the most part terminate at spots where the tissue in question is deficient. The latter is rather composed of undeveloped thread-cells, and is precisely homologous with that urticating-pad which surrounds the anterior stomachal portion of the sucking-tubes. By the great development of this urticating-pad the proven-triculus is divided into four or five vessel-like canals, which subsequently, in *Porpita*, become increased to eight canals. In the absence of a secondary ectoderm after the development of the chitinous concentric air-chambers the Velellidæ are quite unable to secrete any gaseous mixture, but they are confined to taking the atmospheric air into the chambers and expelling it again through the stigmata. As the colony is subjected to a very intense material change, as is shown by the abundant separation of guanine crystals in the so-called liver, it is clear that sufficient oxygen is conveyed to the polyps by means of the air contained in the tracheæ. Moreover the *Velella* and *Porpita* perform movements which remarkably resemble the actions of the air-breathing Arthropods for the removal of the air contained in the tracheæ. Thus if we observe a freshly captured *Velella* or *Porpita*, we find that twice in a minute (seldom oftener) the surface turned towards the water and bearing the sexual polyps and the central stomachalsac (siphosoma, polypite) is very energetically pressed against the air-chambers. During this respiratory movement, caused by the contraction of the circularly arranged muscular fibres, the whole of the polyps, with the exception of the tentacles, are simultaneously contracted. The tentacles are moved downwards independently of the above-mentioned movements, either all together or in groups. After the contraction the lower surface of the disk returns slowly into its position of rest, and the polyps begin again to extend themselves, to be again, after the lapse of half a minute, rapidly contracted. For hours this attractive spectacle, which has hitherto been mentioned by no naturalist, may be observed on freshly captured *Velella* and *Porpita*. The effect of such regularly repeated respiratory movements is perfectly clear; by the energetic contraction of the disk and individual polyps the richly ramified tracheal tufts are contracted, their air passes

* Zoolog. Anzeiger, 1887, nos. 261 and 262.

into the chambers, and out through the stigmata of the latter. On the cessation of the contraction fresh air, richer in oxygen, flows in again. The structure of the chambers, their endowment with stigmata and tracheæ, and the regular respiratory movements serving for the renewal of the air lead me (little as this opinion may harmonize with previous conceptions) to see in the *Velellæ* and *Porpitæ* *Colenterata* breathing air, and, indeed, breathing by tracheæ. This notion by no means excludes the occurrence at the same time at all parts turned towards the water of a diffusional exchange with the air absorbed in the sea-water, an exchange which, indeed, plays a part in all air-breathing aquatic animals*.

The *Velellidæ* certainly represent not only the most complicated in structure, but also the most divergent of the *Physophoridæ*. But, as I have already expressly asserted, there is no feature in their organization which cannot be explained by gradual adaptation to an existence at the surface of the sea. I think that I fix the position of the *Velellæ* and *Porpitæ* in the system more correctly by proposing to divide the order *Physophoridae* into two suborders, of which one includes all *Physophoridae* with an unchambered pneumatophore functioning as a gas-gland (*Haplophysæ*), while the other embraces the (partially) air-breathing *Velellidæ* (*Trachophysæ*) furnished with a chambered pneumatophore, stigmata, and tracheæ.

As regards Hæckel's systematic arrangement in other respects I shall take occasion in the sequel to express divergent opinions of subordinate importance. I see with satisfaction that my opinion formerly expressed in these 'Sitzungsberichte' (1882, lii. p. 1170) as to the near relationship between the *Rhizophysæ* and the *Physaliæ*, to which I endeavoured to give expression by the creation of the family *Pneumatophoridae*, is not only adopted by Hæckel, but also well illustrated by a number of most interesting intermediate forms which were obtained by the 'Challenger' from the deep sea.

As regards Hæckel's peculiar "Medusa-theory," which is intended to occupy a conciliatory position between the poly-

* These statements of course do not apply to the interesting "Discalidæ" discovered by the 'Challenger' in the deep sea. These in a certain degree represent *Disconulæ* which have become sexually mature, and it is to be supposed that in them, as in the young stages of *Porpitæ* and *Velellæ*, the gas-secreting ectoderm persists. At any rate they partly want the tracheæ, which occur only from the third or fourth concentric air-chamber onwards. It is possible that they represent young stages of *Porpitæ* which, as I have found to be the case with many *Siphonophora*, ascend to the surface at the commencement of sexual maturity.

organ-theory and the polyperson-theory, he regards the larva of the Siphonophora as a Medusa with dislocated organs and assumes in the developed stocks a profound secondary dislocation of the different constituents of the Medusa. Hæckel's results so nearly approach the views of Metschnikoff*, who interpreted the Siphonophoran larva in the same way, and who likewise compared the developed colony to a *Sarsia* with the stomach grown out into a peduncular form and gemmiparous, that I must once more adduce all the difficulties which Lenckart†, and subsequently Claus, raised against the views of Metschnikoff and P. E. Müller. Even now, when we possess a sufficient knowledge of the polymorphous Medusæ and their processes of gemmation, there is nothing to support the notion of a dislocation. So long as we have no demonstration that nectocalyx, stomachal tube, tentacles, and bract (hydrophyllium) are produced by dislocation from a single bud, so long as the difficulty is not got rid of that, on the other hand, three or four separate buds, originally quite similar, concur in the formation of a monogastric Siphonophoran, which, *in toto*, is homologous with a Medusa, I must decline to admit the assumption of such a dislocation. On the contrary, when rudiments of tentacles, marginal corpuscles, and manubria make their appearance on the nectocalyces of the Siphonophora, we always see them indicated upon the ordinary spots. How such rudiments, which are observed especially upon the nectocalyces of the genus *Lilyopsis*, established by me, can be brought into accordance with dislocation completed at the same time, is to me just as incomprehensible as Hæckel's and Metschnikoff's supposition that the value of individualities belongs only to the genital nectocalyces and the recently demonstrated "aurophores." The genital calyces themselves present such profound retrogressions that, in the form of sporosaes, they left Weismann in doubt whether we have here to do with retrograde Medusæ or Polypes. We never observe such far-reaching reductions in the locomotive elements, which always show their velum, the fine musculature of the subumbrella, the ordinary course of the vessels, and in all cases a nerve-ring at the margin of the umbrella, as I have been able to demonstrate in all the calyces (most distinctly developed in the species of *Abyla*).

To what inconsistencies Hæckel's views lead may be further

* 'Verhandlungen der Gesellsch. für Naturk.' (Moscow), vol. viii. 1870 (in Russian), and, further, Zeitschr. für wiss. Zool. Bd. xxiv. (1871), pp. 65-77.

† "Bericht &c.," in Arch. für Naturg. Jahrg. xl. (1874) ii. pp. 183-184, and Jahrg. xli. (1875) ii. pp. 452-459.

illustrated by an example. As is well known, there are Eudoxiæ which, besides the genital calyx, possess a special sterile nectocalyx destitute of manubrium. The latter, according to Hæckel, represents a Medusan persona, when he assumes that in it the manubrium has been suppressed by retrogression. But why are we to regard the locomotive elements merely as organs, seeing that they possess exactly the same attributes as the special sterile nectocalyx? I readily admit that it may be a matter of dispute whether in the polymorphic colony we are to regard the bracts and tentacles as individuals or as organs, although Hæckel himself cites facts (such as the occurrence of a small umbrella on the bracts of *Athorybia* and *Ithedophyso*) which might support the former notion. If the dispute were to turn only upon the precarious determination of the boundary between individual and organ I would not proceed further in this place; but the special form in which Hæckel clothes his statements induces me to test more closely his assertion as to the characteristic attribute of the Physophoridae, namely the pneumatophore.

I am glad in the first place that Hæckel adopts my view as to the homology of the primary nectocalyx of the Calycophoridae and the pneumatophore of the Physophoridae. I believe that by the demonstration in the Calycophoridae of a primary calyx which is thrown off and replaced by heteromorphic secondary calyces, as well as by the homologization of this nectocalyx with a Medusa converted by change of function into a pneumatophore, a step in advance is made with regard to the explanation of the production of that hydrostatic apparatus. As to the fact that the pneumatophore represents a metamorphosed Medusa, *i. e.* umbrella, all observers are in accord; it is only in the special proof that they differ essentially from one another. Metschnikoff, as is well known, regards the pneumatophore as an everted Medusan umbrella, of which the exumbrella has been converted into the internal cavity filled with air. If this conception should be verified, an essential difficulty in the way of the comparison of a Physophorid to a budding *Sarsia*, namely the dislocation of the gemmiparous manubrium, would be got rid of. We should then only have to explain how in this case, in the homologous primary nectocalyx of the Calycophoridae, the stomachal peduncle with its buds does not hang out from the subumbrella, but appears dislocated upon the exumbrella. But the history of development cannot in any way justify such a view. The ectodermal bud-nucleus, by means of which the pneumatophore is founded, is perfectly homologous with the bud-nucleus which forms the subumbrella of all

Medusæ and also specially the primary nectocalyx in the Calycephoridæ. I am therefore the more surprised that Hæckel declares categorically:—"This latter conception is, in my opinion, quite erroneous; the former, in a certain sense, admissible. The comparative ontogeny of the Siphonophora appears to me to prove definitely that the air-sac is an apical gas-gland of the exoderm, which in the Disconula of the Disconanthæ immerses itself into the jelly of the umbrella centrally at the vertex of the umbrella, but in the Siphonula of the Siphonanthæ excentrically near the vertex."

In the first place as regards the last observation, in which the endeavour to establish a fundamental distinction between the Disconula and the Siphonula is revealed, it is not at all correct. In simple Physophoridæ, as, for example, in the larva of *Halistemma pictum*, the pneumatophore originates exactly at the apical (aboral) pole of the ciliated larva, as Metschnikoff has already correctly shown, and as I was able to ascertain in the Canarian species.

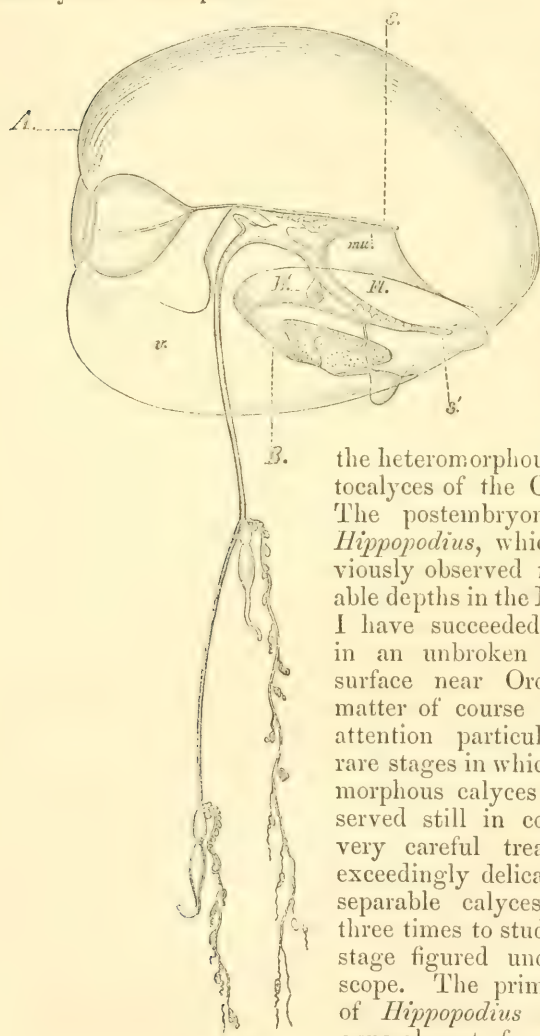
While, on the other hand, Metschnikoff leaves us in no doubt as to where, according to his view, we have to seek the subumbrella of the Medusa modified into a pneumatophore, we find in Hæckel no indication of a part of the pneumatophore homologous with the subumbrella. Nor does he adduce from the comparative ontogeny of the Siphonophora any fact which can justify his view. I have myself previously appealed emphatically to developmental history, and can now once more assert that the ciliated larva of *Halistemma* is similar in form to the larvæ of Calycephoridæ of the same age. Why, then, in the one case we should admit that the ectodermal introverted bud-nucleus becomes developed into the subumbrella of the primary nectocalyx, while in the other a part of the exumbrella proceeds from the bud-nucleus, which is introverted in exactly the same manner, is incomprehensible to me, and contradicts all observations upon the comparative ontogeny of the Siphonophora.

I must admit that Hæckel's "Medusa Theory," both in its general foundation and in its special working out, seems to me not to be a fortunate attempt to combine the opposite views of Huxley, Metschnikoff, and P. E. Müller with those of Leuckart and Vogt, with the latter of which Hæckel also formerly agreed.

Passing now to my statements with regard to the Canarian Siphonophora, which, indeed, must have a modest

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appearance when compared with the astonishingly rich and interesting material which Hæckel had at his disposal in the Siphonophora captured by the 'Challenger' in the deep sea and those observed by himself in various seas, on the one hand I hope to be able to characterize some forms which may claim to be of general interest, and on the other I believe I have here and there also enlarged our knowledge of the post-embryonal development.



Dealing in the first place with the latter subject, I figure here a developmental stage in the post-embryonal evolution of *Hippopodius* which may serve for the elucidation of the above remarks upon

the heteromorphous primarynec-tocalyces of the Calycophoridae. The postembryonal stages of *Hippopodius*, which I had previously observed from considerable depths in the Mediterranean, I have succeeded in capturing in an unbroken series at the surface near Orotava. As a matter of course I directed my attention particularly to those rare stages in which both heteromorphous calyces are to be observed still in connexion. By very careful treatment of the exceedingly delicate and readily separable calyces I was able three times to study in detail the stage figured under the microscope. The primary calyx (A) of *Hippopodius luteus* is of a general ovate form and presents

at the broader pole a comparatively small subumbrella with the velum, the four vessels, and the annular canal. The connecting vascular canal, as also the elongated and very fine fluid-receptacle (*s*) takes a nearly horizontal course. The comparatively large sheath (*e*) reaches exactly to the fluid-receptacle and extends to the inferior margin of the subumbrella. The young colony is now seated with a broad base upon the fluid-receptacle of the primary calyx. As regards the first-formed definitive *Hippopodius*-calyx (*B*) it shows perfectly the characteristic horse-hoof form. As its peculiar form has been sufficiently described by previous observers, I mention only that the upper radial vessel traversing the middle of the subumbrella already shows the characteristic lateral ramifications which lead to the formation of the vascular plate with its numerous anastomoses. The fluid-receptacle (*s'*) runs out into the section of the stem on which the calyces bud between the lateral wings (*Fl*) of the secondary calyx. The rudiment of a second secondary calyx (*B'*) in the form of a rounded bud, at the base of which a small thickening already indicates the formation of a third calyx, is distinctly recognizable. The cushion-like thickening of the stem by which the attachment to the primary calyx is effected consists of endodermic cells rich in fluid, upon which lies an ectodermal muscular layer (*mu*) projecting in the form of a lamella. By the contraction of the latter the secondary calyx is drawn into the superior section of the sheath on the slightest contact. If the two calyces separate from each other the above-mentioned cushion, with the muscular layer, begins to shrivel up; but it may still be recognized for a long time in young colonies.

In the further progress we come first upon the youngest group of polyps, consisting of a young stomachal tube (polypite, *Huxl.*) and a tentacular bud. Two further developed groups, of which the tentacles already show the characteristic urticating batteries with their yellow pigment, hang out of the sheath upon the elongated stem.

I content myself here with the description of this characteristic stage, as I shall shortly give elsewhere a full description of the postembryonic development of *Hippopodius*.

In giving now brief characters of the Canarian Siphonophora, at the same time inserting occasional remarks upon their young stages, I may remark that I cannot approve of Hæckel having so extensively replaced the older and often long-established denominations of the orders and families by new ones, which are frequently but little altered and scarcely more applicable (as, for example, Calycophoridae and Pneumatophoridae by Calyconectae and Cystonectae).

Order I. CALYCOPHORIDÆ, Leuck.

As is well known, a part of the Calycophoridae is remarkable for the faculty of producing Eudoxiæ. Hæckel is of opinion that the two generations, the monogastric (the Eudoxiæ) and the polygastric, must, upon practical grounds, be classified in the system separately and side by side in the same way as the Hydromedusæ and their polyp-nurses. I cannot agree with him in this. A system of Medusæ founded solely upon the sexual animals is so far justified that a great part of the Medusæ are developed directly without any alternation of generations. However, of late noticeable attempts have been made to establish a unitary system of the whole of the Hydromedusæ, taking into account at the same time the Polypes and the Medusæ which remain sessile as gonophores. Besides that the process of *Eudoxia*-formation is not to be paralleled unconditionally with the budding of the Medusæ (even though, like Hæckel, P. E. Müller, and Metschnikoff, we were to refer a part of the Eudoxian colony to dislocated organs of a Medusa), there is no Eudoxia which is directly developed in such a manner that a Eudoxia is produced directly from the ciliated embryo. We may recognize all so-called monogastric colonies, after the discovery of Sars, Leuckart, Vogt, and Gegenbaur, as descendants of polygastric Siphonophora. The attempt to establish a peculiar system of Eudoxiæ leads to the citation of the families of the latter as categories equivalent to the families of the parent-colonies. Fundamentally, in Hæckel's system three systems of Calycophoridae run parallel to each other, one of them founded upon the liberated Eudoxiæ, the second upon the nectocalyces of the parent-colonies belonging to them, and the third upon those Calycophoridae in which the Eudoxiæ remain sessile. Such an attempt leads to the further inconsistency that in the different families of the Eudoxiæ, which are characterized by the form of the hydrophyllia, of the gonocalyces and special calyces, Eudoxiæ are united which originate partly from Monophyidae and partly from Diphyidae. As, further, nearly allied species present sometimes liberable, sometimes permanently sessile Eudoxiæ, I prefer to avoid an unnecessary complication of the system and treat of the Eudoxiæ along with their parent-colonies.

Family I. Monophyidae, Claus.

Huxley was the first to describe and figure recognizably a Monophyid under the name of *Spharonectes*. It possesses

perfectly the characters of the form subsequently described by Claus as *Monophyes gracilis*. I would therefore propose to refer those species which are characterized by an elongated tubular sheath running to the middle of the umbrella to the genus *Sphæronectes*, and, on the other hand, to retain the generic name of *Monophyes* for those species which are distinguished by a short funnel-shaped sheath, reaching only to the lateral walls of the subumbrella (after the type of *Monophyes irregularis*, Claus).

Häckel divides the Monophyidæ into two subfamilies—Sphæronectidæ and Cymbonectidæ. I adopt this division because as yet we have no evidence of a primary heteromorphous nectocalyx in the Sphæronectidæ, whereas with regard to the Cymbonectidæ with angular calyces I have furnished evidence of a primary calyx in *Muggiæa**. I would, however, remark that the form of the rounded cap-shaped calyces of the Sphæronectidæ is recapitulated in the development of the Calycophoridæ.

Subfam. 1. SPHÆRONECTIDÆ, Huxl.

1. *Monophyes brevituncata*, sp. n.

Umbrella thin-walled. Oil-receptacle relatively large, ascending almost perpendicularly. Stem abbreviated, presenting, besides the undeveloped buds on the basal portion, only two groups of appendages (*cormidia*, Häck.). The latter are set free as *Diplophysæ*, which resemble in appearance those of *M. irregularis*. They differ from these by their relatively smaller hydrophyllium, which is traversed by a considerable oil-receptacle, reaching nearly to the top of the hydrophyllium. The gono-nectocalyx is very large, thin-walled, and shows at its base the rudiments of two reserve-calyces. I name it *Diplophysa codonella*. Once I observed a perfectly developed *Diplophysa*-group at the extremity of the stem, a proof that the groups only separate late and that the stem always remains remarkably short.

Monophyes brevituncata appeared very sparingly with the groups belonging to it in the course of the winter and spring.

2. *Monophyes irregularis*, Claus.

3. *Sphæronectes gracilis*, Claus (*S. Küllikeri*?, Huxl.).

The two last-named Monophyidæ appeared more abundantly.

* Sitzungsab. Akad. Wiss. Berlin, 1882, ii. p. 1155.

dantly than *M. brevitruncata*, together with the Diplophysæ belonging to them (*D. inermis* and *truncata*) from September to April.

Subfam. 2. *CYMBONECTIDÆ*, Hæckel.

DORAMASIA, g. n.

Nectocalyx Diphyidiform, slender, with a long, tubularly drawn-out apex to the subumbrella. Eudoxiæ with sterile special nectocalyces (*Ersæa Bojani*, Esch.).

4. *Doramasia picta*, sp. n.

Sheath (hydræcium) elongated, funnel-shaped. Oil-receptacle long, reaching to the tubular constriction of the subumbrella. Stem short, with only two groups of appendages. *The Eudoxiæ become developed into Ersæa Bojani, Eschsch.* (*Eudoxia Bojani, Huxl.*).

Doramasia represents a remarkably elegant Monophyid which immediately strikes one by its splendid colouring. The ventral surface of the subumbrella with its tubular portion is of an intense orange or bright yellow colour. Large orange spots also appear on the dorsal and ventral margins of the umbrella, and, further, the siphosoma (polypite) of the oldest group is also very frequently intensely tinged with orange. The lowest ventral cell of the fluid-receptacle is constantly emerald-green (changing by transmitted light to the complementary rose-colour). Frequently at the opening of the dorsal umbrellar vessel into the annular canal there is a vascular plate formed by numerous ramifications and anastomoses, which also has a greenish lustre.

The strict proof that a Siphonophore furnished only with a single nectocalyx really belongs to the Monophyidæ can be obtained, according to my previous statements, only by that of the absence of the rudiment of a second calyx at the base of the stem. I have examined nearly forty specimens of *Doramasia* upon this point at the most different times, and have often preserved and carefully observed the same individual for several days without being able to detect a trace of a second calyx.

Hæckel, in his tabular revision, regards *Ersæa Bojani* as the offspring of *Diphyes dispar*, Cham.; but this can only be upon suppositions which are not confirmed. I have traced *Ersæa Bojani* with its characteristic widened oil-receptacle in the scutiform hydrophyllium, in all stages of development,

still seated upon the stem of *Doramasia*. I may further mention that *Ersaea Bojani*, which often presents at the same time four or five small gonocalyces in different states of maturity, is dicecious. The male calyces when quite mature present a somewhat reddish manubrium occupying nearly the whole cavity of the subumbrella.

Doramasia picta attains a size of 6–10 millim. and appeared pretty frequently during the whole period of my residence in the Canaries. In its name of the Canarian national hero, Doramas, may be commemorated.

5. *Muggiæa Kochii*, Chun.

Appeared singly during the winter months with the *Eudoxiæ* belonging to it—*Ersaea pyramidalis*, Will (*Eudoxia Eschscholtzii*, Busch).

HALOPYRAMIS, g. n.

The nectocalyx forms a broad, four-sided, tetragonal pyramid. Hydroecium infundibuliform, with a projecting denticulate margin. Oil-receptacle very large, situated in the axis of the pyramid. Subumbrella excentric. Stem abbreviated, not protrusible. *Eudoxiæ* without special nectocalyx, becoming free as *Cuboides*.

6. *Halopyramis adamantina*, sp. n.

The base of the pyramid is octangular in so far that in the inferior third two edges are attached to each of the four widely projecting angles, and these, running downwards obliquely, meet together in four inferior angles which alternate with the four upper ones. The large, fusiform, centrally placed oil-receptacle is furnished on its basal surface with fluid-cells of very considerable size. Stem abbreviated, disciform, beset with numerous groups of buds. The *Eudoxiæ*, which are liberated in the form of *Cuboides adamantina*, mihi, grow to a considerable size, are monœcious, and usually present at the same time two gonocalyces and several (up to three) reserve-calyx-rudiments.

Halopyramis adamantina is one of the most remarkable Canarian forms, not only on account of its peculiar form, perfect transparency, and comparatively large size (the calyx reaches a height and breadth of 15 millim.), but also on account of the abbreviation of the stem. I never saw this extended, even in specimens which were kept quietly for two

days in glasses. Moreover, no convolutions can be recognized in it, although it is difficult to get a view of it on account of the closely packed groups with their orange-coloured cnidaria. I shall have to call attention to a similar conversion of the stem into a disciform plate in a *Diphyid*. The genus *Halopyramis* certainly stands near the genus *Cymba*, under which, however, Eschscholtz certainly united creatures of very different kinds. It is possible that *Cymba enneagonum* (*Enneagonum hyalinum*, Quoy et Gaimard*), which has been so frequently determined erroneously, is related to, if not identical with, *Halopyramis adamantina*. Quoy and Gaimard certainly ascribe to it a small inferior calyx, and therefore afterwards referred it to *Diphyes*; but it is conceivable that here we have a confusion with a genital nectocalyx of a *Eudoxia* already far advanced in development.

Halopyramis is perfectly transparent; in large specimens the eight angles and the umbrellar margin of the calyx are of a yellowish colour; sometimes yellowish spots also appear on the subumbrella. The oval oil-drops, as well as those in the hydrophyllium of the *Cuboides*, have an orange lustre. The polypes shimmer emerald-green beneath the urticating-pad.

Cuboides adamantina represents one of the largest and most splendid *Eudoxiæ*. The cuboidal hydrophyllium with its aliformly produced edges and concave lateral surfaces attains a size of 10 millim., and the older gonocalyces are of the same length. On the yellowish oil-receptacle the fluid-cells occurring on the ventral surface of the lateral diverticula may be recognized by the naked eye.

Cuboides vitreus, Huxley, resembles it, but is distinguished by the shorter dorsal surface of the hydrophyllium (which is much produced in *C. adamantina*). Favoured by its size and transparency I was enabled to trace out many minute histological details, upon which I will not enter here, better than in any other *Eudoxia*.

Halopyramis and the *Cuboides* belonging to it appeared singly and rarely during January and February.

From the revision of the Canarian Monophyidiæ here given it appears that their *Eudoxiæ* are remarkably different from one another. They belong to the two families of the *Eudoxiæ* and *Ersæidiæ* distinguished by Hæckel, with the sub-

* 'Voyage de l'Astrolabe': Zool. Zooph. pl. v. figs. 1-6, vol. iv. p. 100; Ann. Sci. Nat. vol. x. (1827), p. 18, pl. ii. D. figs. 1-6.

families of the Diplophysidæ and Aglaismidæ. I mention this circumstance only in order to show how doubtful it is to introduce the progeny of a well-characterized family into the system as representatives of equivalent families.

Family II. Diphyidæ, Eschsch.

Subfam. 1. *EPIBULIDÆ*, Hæck.

Hæckel characterizes the genus *Epibulia* by the absence of an hydroecium. As, however, indications of such a thing are given by the produced wing-like edges of the inferior nectocalyx, and on the other hand *Diphyes subtilis* has no hydroecium in the superior nectocalyx, I would note as a further distinctive character from *Diphyes* the maturation of the sexual products on the stem and the absence of a *Eudoxia*-formation. It is true that in freshly captured *Epibulia aurantiaca* the *Eudoxia*-groups rapidly separate, but we never meet with these groups already furnished with mature semen and ova floating freely in the sea. It is also in accordance with this that (at least in the Canarian forms examined by me upon this point) no reserve-gonocalyces occur.

7. *Epibulia inflata*, sp. n.

Umbrellar jelly of both calyces thin-walled. Subumbrella of the superior calyx swelled out. Oil-receptacle comparatively large (from one third to half as long as the subumbrella), ovate, and furnished on the ventral surface with large fluid-cells. Ventral wings of the inferior calyx well developed. Course of vessels simple, as in the calyces of Diphyids; margins of both calyces smooth, without projecting wing-like angles; stem short, monœcious. The last groups of appendages lose the bract, stomachal sac, and tentacles, so that only the gonocalyx remains on the stem.

Epibulia inflata is a small, easily recognizable Diphyid, measuring 10 millim., which appeared singly and in very few examples during the winter. Both the subumbrellas have a delicate rosy tint; only once I found them with orange spots.

8. *Epibulia monoica*, sp. n.

Nectocalyces and course of vessels on the subumbrella resembling those of *E. aurantiaca*; but the diverticula of the subumbrella of the inferior nectocalyx are wanting, and the fluid-receptacle is very small. Stem monœcious; one

female group to every four to six male groups. In the last groups of appendages first the stomachal sac and tentacles and finally the bract become rudimentary.

Epibulia monoica is a very characteristic Canarian form, in which I was able to trace with particular exactitude the peculiar retrogression of the *Eudoxia*-groups. Usually in the older examples we find at the end of the stem from four to six gonocalyces, to which the rudiments of the shrunken *Eudoxia*-constituents adhere. The mature testes are rose-coloured, and, like the mature ovaria, occupy nearly the whole of the subumbrellar space. The species under consideration has in common with *Epibulia aurantiaca* not only the convolutions of the vessels, but also the commissure between the lateral and ventral vascular stems in the superior calyx. It is distinguished therefrom, besides the above-mentioned characters, by the different formation of the so-called closing valves on the margin of the umbrella. From the two species described by Sars*, *E. truncata* and *E. biloba*, as also from *E. Sarsii*, Gegenbaur †, it differs by the small size of the fluid-receptacle and the complicated structure of the umbrellar margin.

The polypites are very slender, with an elongated cnidarium and a light brown median stomachal section. *Epibulia monoica* attains a length of 28 millim.; in the largest specimen the inferior calyx was twice as long as the upper one. A few examples occurred in January and March.

9. *Epibulia aurantiaca*, var. *canariensis*.

I observed a species nearly allied to *E. aurantiaca*, and, like this, dioecious, twice in March. It showed the diverticula of the subumbrella less strongly developed on the inferior calyx and presented some differences in the development of the teeth projecting from the umbrellar margin. As, however, the differences are probably only unimportant, I regard the Canarian form for the present only as a variety of *E. aurantiaca*.

10. *Diphyes subtilis*, Chun.

D. subtilis makes the transition between the genera *Epibulia* and *Diphyes*. It has no hydroecium and, like the true *Epibulia*, possesses wing-like edges on the inferior calyx, but has in common with the *Diphyids* the formation of sepa-

* 'Fauna littoralis Norvegiæ,' i. (1846), pp. 41-46, pl. 7.

† Nova Acta Ac. Cæs. Leop.-Car. xvii. (1859) p. 372, pl. xxix. fig. 30.

able *Eudoxiæ* with reserve-gonocalyces. As I showed in 1886*, *Ersava elongata*, Will, represents the *Eudoxia* belonging to *D. subtilis*.

It appeared singly and not so frequently as in the Mediterranean during the whole winter.

11. *Diphyes bipartita*, Costa.

The common Diphyid of the Mediterranean (*Diphyes Sieboldii*, Köll., *D. gracilis*, Gegenb., *D. acuminata*, Leuck.) is abundant both in the depths and at the surface of the Atlantic Ocean, and appeared, with the *Eudoxia* pertaining to it (*Eudoxia campanula*, Leuck.), throughout the whole winter.

12. *Diphyes serrata*, sp. n.

Nectocalyces more slender than those of *D. bipartita*, with strong projecting teeth on the umbrellar margin. Ridges on the dome of the superior nectocalyx produced into wings. *Eudoxiæ* like *Eudoxia campanula*, with a very slender long bract.

Diphyes serrata appeared abundantly during the whole winter. Its *Eudoxiæ* (*Eudoxia serrata*, m.) are easily recognized by the slender bract, resembling an arrow-head. They attain a considerable size (as much as 8 millim.) and have sulphur-yellow cnidaria.

13. *Diphyopsis campanulifera*, Q. & G.

The large and beautiful *D. campanulifera* is the commonest Diphyid occurring at the Canaries and apparently throughout the Atlantic Ocean. It appeared regularly from the end of October onwards, and I observed it in great swarms in the larger currents during a passage from Teneriffe to Palma in March. It is possible that *Diphyes dispar*, Cham. & Eysenh.†, is identical with it; under this latter name it has also been thoroughly described by Huxley. However, a careful investigation furnished me with much information as to the change of the nectocalyces and the occurrence of a large vascular plate, consisting of numerous anastomoses, at the lower ventral section of the nectocalyces. Its *Eudoxia*-groups become developed into the *Eudoxia Lessonii*, Huxley‡, furnished with

* Sitzungsab. Akad. Berl. xxxviii.

† Nova Acta Ac. Ges. Leop.-Car. x. (1822), p. 365, pl. xxxii. fig. 4.

‡ 'The Oceanic Hydrozoa,' p. 57, pl. iii. fig. 6.

a sterile special nectocalyx, which may be identical with the *Eudoxia* described by Eschscholtz * under the same name. I need hardly note that the abundant material at hand gave me the opportunity of tracing the development of the *Eudoxia*-groups on the stem through all phases up to their separation. *Eudoxia Lessonii*, like all the *Eudoxiæ* of the genus *Diphyes*, is dioecious. In the older *Eudoxiæ* I generally found a mature gonocalyx with a second smaller one and two rudiments of a third and fourth calyx. The special nectocalyx, into which the calycal bud first formed on the stem is developed, persists and is not displaced by sterile reserve-calyces.

Häckel can only rely upon suppositions in regarding *Eudoxia* (*Cucullus*) *Lessonii* as derived from the *Diphyes appendiculata* insufficiently described by Eschscholtz.

Older specimens of *D. campanulifera* possessed a sulphur-yellow subumbrella on both calyces. The special nectocalyx of *Eudoxia Lessonii*, which is furnished with yellow spots, has usually a delicate emerald-green lustre.

Subfam. II. *ABYLIDÆ*, Ag.

Besides the characters given by Agassiz and Häckel, it may be indicated as characteristic of the *Abylidæ* that their *Eudoxiæ*, in contrast to those of the *Epibulidæ*, are monoecious.

14. *Abyla trigona*, Q. & G.

From the middle of December onwards *Abyla trigona* occurred, at first in single specimens, but later on (at the end of February and in March) in great swarms. That their groups of appendages become developed into *Amphirrhoa alata*, Lesueur, which I regard as identical with *Eudoxia trigona*, Gegenb., was rightly supposed by Huxley, and proved by Gegenbaur (*loc. cit.* p. 347). I met with the *Amphirrhoa* as early as October.

15. *Bassia perforata* (*Bassia quadrilatera*?, Q. & G., *Abyla bassensis*, Huxl., *Abyla perforata*, Gegenb.).

The present species, which was undoubtedly discovered by Quoy and Gaimard, and afterwards figured by them as *Diphyes bassensis* †, is a very abundant form and appeared at

* 'System der Acalephen,' p. 126, pl. xii. fig. 2.

† 'Voyage de l'Astrolabe,' Zoophytes, pl. iv. fig. 18.

the Canaries throughout the whole winter. It descends into deep water, as I obtained a specimen in the closed net from 500 metres. Huxley correctly surmises that the *Eudoxia*-groups of *Bassia* become developed into *Sphenoides australis*, Huxl. This supposition I can confirm by direct observation.

16. *Abylopsis* * *quincunx*, sp. n.

It is remarkable that hitherto all observers have confounded with each other the two most abundant species of *Abyla*, namely the Mediterranean *Abyla pentagona* and the Atlantic species, which is always much smaller. The Atlantic form, with its characteristic hydroecium produced into the form of a neck, is easily distinguished from the *Abyla pentagona* of the Mediterranean, in which the small superior calyx is seated by a broad base upon the inferior one. Huxley has very recognizably described and figured the Atlantic species as *Abyla pentagona* (*loc. cit.* p. 40, pl. ii. fig. 2). As Quoy and Gaimard figure the Mediterranean form under the name of *Calpe pentagona*, I give the Atlantic one that of *Abylopsis quincunx*.

Their *Eudoxia*-groups are developed into *Aglaismoides Eschscholtzii*, Huxl., as I have been able to trace in detail. The latter differs in the form of the bract from the *Eudoxia cuboides* which belongs to *A. pentagona*.

17. *Ceratocymba spectabilis*, sp. n.

As *Ceratocymba* I describe the only *Eudoxia*, the derivation of which from a previously known *Abyla* I am unable to demonstrate. I regret the more that the polygastric colony to which it belongs did not occur, as it must certainly be a very remarkable form; for the splendid *Ceratocymba*, which is not less than 23 millim. long, represents the largest of all known *Eudoxiæ*. It consequently attains the length of a full-grown *Abyla trigona* or *Abylopsis pentagona*.

The large bract resembles a helmet with two laterally projecting triangular horns. The remarkably large oil-receptacle is curved like a note of interrogation (?), and is produced at its tip into two very long canals passing obliquely outwards into the angular processes of the bract. The dorsal surface of the oil-receptacle is coated with particularly large fluid-cells

* As the generic name *Calpe*, employed by Quoy and Gaimard, had already been made use of by Treitschke in 1825 for a butterfly, I propose to replace it by *Abylopsis*. In the conception of the genus I follow Huxley.

visible even to the naked eye. The polypite and tentacles show the ordinary structure; the long orange-coloured batteries are provided with a particularly strong elastic band twisted like a rope.

The gono-nectocalyces are always two in number, and, indeed, one is male and the other female in development, a condition which I have already noted as characteristic of the Eudoxiæ of the Abylidæ. The manubrium, which is occupied by the sexual products, is remarkably small in proportion to the enormously large calyces. The latter measure nearly 2 centim.; the length of the subumbrellar cavity in the larger calyx amounts to 13 millim. Their four edges are produced in a wing-like form and run out at the margin of the umbrella into tooth-like angles, one of which is developed to a considerable length. I could always observe two or three reserve-gonocalyces in different stages of development. Their size alternates quite regularly, so that, if the largest calyx of the Eudoxia is male, the somewhat smaller one which appears at the same time is female; upon this follows a male reserve-calyx, and then again a small bud, which, however, already shows the rudiments of the ova in the manubrium.

Ceratocymba spectabilis occurred rarely and singly from January to March. The bract behaves very remarkably under strong contact, inasmuch as upon irritation a whitish turbidity makes its appearance, first in the neighbourhood of the two horn-like canals of the oil-receptacle, and afterwards, commencing from the angles, also in the whole of the gelatinous mass. This is due to the appearance of extremely fine granules, which again disappear (in about half an hour) if the Eudoxia is left in repose. The peculiar turbidity reminds one of an analogous phenomenon in *Hippopodius*, only that there the milky coloration consequent upon irritation and afterwards disappearing is connected with the ectodermal cells of the nectocalyces. In a certain sense even the structureless jelly of the bract must be accessible to an irritation, as the gradual manifestation and equally gradual disappearance of a tolerably intense turbidity proves.

It is evident that a Eudoxia from the Straits of Gibraltar described by Quoy and Gaimard* as *Cymba sagittata* is allied to the *Ceratocymba* here described. At any rate the genus *Cymba* represents a Eudoxia and not a Monophyid, in which latter sense the generic name is adopted by Hæckel. As, moreover, the name *Cymba* was employed for a mollusk as early as 1826, it must be withdrawn here.

* Ann. Sci. Nat. vol. x. (1827), p. 16, pl. ii. c. figs. 1-9.

The Abylidæ here cited furnish remarkable objects for the study of the finer histological characters. Besides the magnificently developed transversely striated subumbrellar musculature, the endoderm-cells of the calycular vessels, especially in those places where anastomosing vascular plates occur, furnish perfectly classical objects for the study of a direct nuclear division taking place without karyokinesis. The endoderm-cells are often filled with a whole brood of nuclei, produced by the constriction or by the breaking up of one large nucleus, sometimes curiously sausage-shaped or ramified. It has also already been mentioned that, in the species of *Abyla*, I have detected at the margin of the umbrella a nervous ring consisting of elongated, bipolar, fusiform cells.

Subfam. III. *AMPHICARYONIDÆ*, Chun.

Nectocalyces with a rounded exumbrella, stem metamorphosed into a disk. The bud-groups are set free as diplophysiform Eudoxiæ.

AMPHICARYON, g. n.

Nectocalyces of unequal size; oil-receptacle of the cap-shaped bract with two long lateral canals.

18. *Amphicaryon acaule*, sp. n.

Nectocalyces in young examples of nearly equal size; in older specimens the larger calyx completely encloses the smaller one by means of two lateral wings. The latter possesses an ascending and a descending fluid-canal, the former only an ascending stem reduced to a disk, on which the first groups bud forth ventrally, and the later ones also laterally. They are set free as diplophysiform Eudoxiæ without special nectocalyx, which I name *Diplodoxia acaulis*. The rounded cap-shaped bract possesses a deep ventral fissure. The roundish oil-receptacle is comparatively small, but the two canals descending obliquely from it are pretty long. The polypites are relatively thin-walled; before the separation of the Eudoxiæ they are generally seated, curved into a semi-circular form, upon the disciform stem. The tentacles are of a delicate yellowish colour; in the small batteries five larger strongly refractive cnidarian capsules are remarkable on each side. The tactile filament is usually intensely orange-coloured. The gono-nectocalyces show on the ventral surface a groove bounded by wing-like processes.

Amphicaryon acaule appeared singly from December onwards to April: the Eudoxiæ belonging to it were observed as early as October. In older examples the smaller calyx was flattened out like a bowl and immersed in the larger one. The subumbrella of the smaller calyx is in all forms so small that it may easily be overlooked.

Amphicaryon becomes 15 millim. long, and, not only by the peculiar form of its calyces, but above all by the retrogression of its stem, represents one of the most noteworthy of the Canarian Siphonophora. It has, in common with the Diphyidæ already mentioned, the formation of Eudoxiæ, while by the rounded form of the calyces it makes the transition to the Prayidæ.

Subfam. IV. *PRAYIDÆ*, Köll.

19. *Praya maxima*, Gegenb.

Occurred much more rarely than in the Mediterranean in perfectly sexually mature examples during February. In many groups two mature male or female gonocalyces were developed at the same time.

20. *Lilyopsis diphyes*, Vogt.

Observed only once, at the beginning of October.

Family III. *Stephanophyidæ*, Chun.

Calycophoridæ with four nectocalyces placed like a wreath in the same plane and with heteromorphous tentacles.

STEPHANOPHYES, g. n.

Nectocalyces with the oil-receptacle repeatedly divided dichotomously. Stem monœcious. Appendicular groups constructed like those of the genus *Lilyopsis*, remaining sessile. In the internodes are seated heteromorphous tentacles, with small balaniform cnidaria without tactile filaments.

21. *Stephanophyes superba*, sp. n.

Nectocalyces similarly formed, resembling those of the genus *Lilyopsis*, with repeatedly dichotomously divided fluid-vessels, swollen into knots, and a large nectosac. Numerous reserve-nectocalyces present at the commencement of the

stem. Lateral subumbrellar vessels running in arabesque-like convolutions.

Gastric polyps transparent, with long peduncles and a long proventriculus. At the junction of peduncle and proventriculus originates the principal tentacle, with spirally coiled, transparent, large bluish cnidaria. The older ones are faintly coloured red; all are provided with long tactile filaments. At the base of the cnidaria a black pigment spot.

Special nectocalyces originate at the base of the stomachal peduncle close to the stem and remove subsequently proximally from the latter. Their axial vessel gives off a dorsal and a central branch; the lateral subumbrellar vessels have a twisted course. At the ventral surface the gelatinous mass is widely produced in a wing-like form.

The sexual buds are seated in bunches (six or seven in number) at the base of the stomachal peduncle. Male and female groups alternate on the same stem; frequently two or three male or female groups follow upon one another. Older male buds are pedunculate, with a small umbrella and an extraordinarily long reddish flesh-coloured manubrium; younger ones have the umbrella crinkled at the margin. Female buds with a small nectocalyx and globular manubrium, which harbours only three or four extraordinarily large and transparent ova.

Bracts resembling a sailor's hat ("sou'-wester"), with six fluid-canals swelled into knobs, lying over one another like roof-tiles.

In the internodes are seated the heteromorphous tentacles hitherto found only in Stephanophyes among the whole group of the Calycophoridae. In the younger groups one tentacle, in older ones three or four, occur in each internode. In the latter case two or three tentacles are attached to a common peduncle. Each tentacle shows at the base a small, oval, mouthless feeler (as in the Physophoridae), and is beset with numerous small, very short-stalked, acorn-shaped cnidaria without tactile filaments.

Of all Siphonophora with which I am acquainted *Stephanophyes superba* is the most delicate and at the same time one of the most magnificent. With perfect transparency it attains a length of $1\frac{1}{2}$ foot. The graceful play of its heteromorphous tentacles, the energetic pumping movements of the large calyces and the numerous special nectocalyces, the bright red colouring of the knobbed fluid-vessels with their shining oil-drops, the delicate rosy or emerald-green shimmer of the gastric polyps, the perfect transparency of the large globular ova, and the delicate flesh-tint of the male manubria,

all combine to mark *Stephanophyes* as one of the most splendid objects among pelagic animals.

Unfortunately its extraordinary delicacy presents great difficulties to investigation. Within an hour or two of its capture it begins to melt away, and none of the modes of preservation employed with good results upon other Siphonophora sufficed even to preserve fragments tolerably well.

From January to March it occurred rarely and singly. In old specimens the stem appears to break up into fragments which are occasionally met with floating. *Stephanophyes* passes through a remarkable metamorphosis. The youngest specimens, perfectly transparent and therefore easily escaping even the practised eye, display throughout the characters of the genus *Lilyopsis*; they possess two nectocalyces with the fluid-canal only once dichotomously divided, and are completely destitute of the heteromorphous tentacles on the internodes of the older groups. These tentacles are subsequently formed between the younger groups, and at the same time a more abundant dichotomy of the fluid-canals makes its appearance even in the reserve-nectocalyces.

Thus *Stephanophyes* constitutes a typical bond of union between the Prayidæ and the Polyphyidæ, while, on the other hand, the occurrence of heteromorphous tentacles with small, astomatous, feeler-like polyps points towards the structural conditions of the Physophoridæ.

Family IV. Polyphyidæ, Chun.

22. *Hippopodius luteus*, Forsk., Q. & G.

Occurred pretty plentifully from the end of December onwards.

In conclusion, I give a summary of the Canarian Calyco-phoridæ which produce Eudoxiæ, adding the names of the authors who demonstrated the relation of the so-called monogastric colonies to the polygastric forms.

I. MONOPHYIDÆ.

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|---|---|
| 1. Monophyes brevitruncata, <i>sp. n.</i> | Diplophysa codonella, <i>Chun</i> , 1888. |
| 2. ——— irregularis, <i>Claus</i> | ——— irregularis, <i>Claus</i> , 1874. |
| 3. Sphæronectes gracilis, <i>Claus</i> .. | Ersæa truncata, <i>Wil.</i> { <i>Claus</i> , 1874. |
| | Diplophysa inermis, <i>Gegenb.</i> { |
| 4. Doramasia picta, <i>sp. n.</i> | Ersæa Bojani, <i>Esch.</i> { <i>Chun</i> , 1888. |
| | Eudoxia Bojani, <i>Huxl.</i> { |
| 5. Muggiæa Kochii, <i>Chun</i> | Ersæa pyramidalis, <i>Will.</i> { <i>Chun</i> , 1882. |
| | Eudoxia Eschscholtzii, <i>Busch.</i> { |
| 6. Halopyramis adamantina, <i>sp. n.</i> | Cuboides adamantinum, <i>Chun</i> , 1888. |

II. DIPHYIDÆ.

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|---|-------|--|----------------------------------|
| 7. <i>Diphyes subtilis</i> , Chun | | <i>Ersæa elongata</i> , Will., Chun, 1886. | |
| 8. — <i>bipartita</i> , Costa | | <i>Eudoxia messanensis</i> , Gegenb. | } Leuckart, 1853. |
| | | — <i>campanula</i> , Leuck. | |
| 9. — <i>serrata</i> , sp. n. | | — <i>serrata</i> , Chun, 1888. | |
| 10. <i>Diphyopsis campanulifera</i> , Q. & G. | | — <i>Lessonii</i> , Esch., Huxl., Chun, 1888. | |
| 11. <i>Abyla trigona</i> , Q. & G. | | <i>Amphirhoa alata</i> , Les. | } Huxley, 1858. |
| | | <i>Eudoxia trigona</i> , Gegenb. | |
| | | | } Gegenbaur, 1860. |
| 12. <i>Bassia perforata</i> , Q. & G. | | <i>Sphenoides australis</i> , Huxl., Chun, 1888 | (sur- mised by Huxley, 1858). |
| | | | |
| 13. <i>Abylopsis quincunx</i> , Chun | | <i>Aglaismoides Eschscholtzii</i> , Huxl., Chun, 1888. | |
| 14. — ? | | <i>Ceratocymba spectabilis</i> , Chun. | |

III. AMPHICARYONIDÆ.

15. *Amphicaryon acaule*, sp. n. *Diplodoxia acaulis*, Chun, 1888.

Order II. PHYSOPHORIDÆ, Esch.

I have repeatedly endeavoured to show that the organism of the Physophoridae displays manifold relations to that of the Calyphoridae, which justify the conclusion that the two orders have a common origin. In this respect I would adduce in the first line the demonstration which I have furnished, that in the embryo of both orders a heteromorphous rudimentary nectocalyx is formed, which in the Calyphoridae is thrown off (perhaps it persists in the Sphaeronectidae), whilst in the Physophoridae it becomes converted into the pneumatophore. If I now mention further that in the more highly organized Calyphoridae the nectocalyces occur of the same form in considerable numbers, that, further, the close concentration of the buds into Eudoxia-groups is given up, and that I am able to cite species in which the stem is transformed, as in many Physophoridae, into a gemmiparous disk, we obtain a whole series of noteworthy relations which seem to indicate that the Physophoridae took their origin, if not from Stephanophyidae or Polyphyidae, certainly from a root common to the two orders. To this may be added finally as an important argument that, by the discovery of the remarkable *Stephanophyes* with its heteromorphous tentacles, a condition is shadowed forth which has hitherto been regarded as an exclusive characteristic of the Physophoridae.

In accordance with my previous statements I divide the Physophoridae into the two suborders Haplophysæ and Tracheophysæ.

Suborder I. HAPLOPHYSÆ, Chun.

Physophoridæ with an unchambered pneumatophore which is partly lined by secondary ectoderm functioning as a gas-gland and which is destitute of tracheæ.

Tribe I. PHYSONECTÆ, Häck.

Family Agalmidæ, Brandt.

23. *Halistemma pictum*, Metschn.

The elegant Agalmid described by Metschnikoff as *Stephanomia picta*, and afterwards by Claus as *Halistemma tergestinum*, is evidently more widely distributed than has hitherto been supposed. It occurred very frequently from January to April, sometimes in enormously long specimens, which displayed as many as thirty-four nectocalyces. As the Mediterranean form was well known to me from previous investigations, I soon convinced myself that the Canarian species is perfectly identical with it. Although *Halistemma pictum* has been accurately described by Metschnikoff and Fuykas and monographically treated by Claus, certain circumstances which have escaped the above-mentioned naturalists seem to me to be not unimportant in connexion with the conditions of growth of the Physophorid stem.

Law of Growth of the Stem of Halistemma.—As is well known, there is at the base of the column of nectocalyces a zone of gemmation from which the youngest incipient groups of the Siphonophore-stem originate. The groups on the stem therefore increase in size in a distal direction; the groups situated at the end of the stem are at the same time also the oldest. In those Agalmidæ and Forskalidæ which are characterized by separated group-appendages ("dissolute Cormidien" of Hæckel) the rule above cited, that the appendages of the stem regularly increase in age (usually also in size) in a distal direction, applies only to the gastric polyps with the tentacles belonging to them. Developmental history shows, particularly as regards *Halistemma pictum*, that, in point of fact, the gastric polyps seated at the end of the stem are the oldest, and that they gradually diminish in age in a proximal direction—that is, towards the nectostyle. It would, however, be a mistake to assume that the same condition prevails with respect to the other appendages of the stem, namely the bracts, palps, palpal filaments, and genital bunches. As most previous observers have already perceived, the latter are met with in

the internodes, *i. e.* in the interval between two polypites, in all stages of development, which originate irregularly dispersed upon the stem. Hæckel himself says:—"Finally all order ceases and the whole stem appears beset with hundreds or thousands of different appendages (siphons, palpones, gonophores, bracts, &c.) irregularly grouped; so that it is impossible to discriminate the different correlated constituents of the dissolved cormidia."

I hope, however, to be able to demonstrate that in *Halistemma* (probably also in the other Agalmidæ and the Forskalidæ) a strict rule prevails in the production of the group-appendages. In *Halistemma*, as is well known, the internodial appendages of the stem (*i. e.* those situated between two polypites) are grouped in such a manner that a palp with its tactile filaments, a bract, and a male and a female gonophore concur to form a group. As I may mention in passing, the female gonophores developing near the palp constantly occupy a proximal, the male ones on the contrary a distal position on the stem. In the individual internodes the number of the groups constantly increases towards the end of the stem; thus, while in the proximal internodes we find only two or three groups, there are 12-15 in the distal internodes. The stem therefore grows internodially, and indeed in such a way that in each individual internode the groups continually decrease in size in a proximal direction. Hence, if we trace the groups of the stem in a distal direction, we find behind the polypite with its tentacles the buds of the youngest group, and then the other groups gradually increasing in size. The youngest group consists of a bud for the polypite and tentacles, and two buds situated close to it, one of which, as the female primordial bud, originates the female gonophores, and the other, as the male primordial bud, the male gonophores. Somewhat more distally comes the bud for the bract.

To show clearly the further conditions of growth in the internode, I indicate by A, B, C... the polypites with the tentacles belonging to them, and by a, b, c... the bud-groups situated in the internode between two polypites. If, then, A and a signify the oldest groups, and B and b &c. the successive younger ones, we should obtain for the last internode of the stem the following formula:—

$$B . h . g . f . e . d . c . b . a . A .$$

At this stage, however, only the younger specimens of *Halistemma* remain. The number of groups in the internode, which in our special case we have assumed to be 8 (*a-h*),

increases continuously, *but at the same time new bud-groups appear between the oldest approximated groups of the internode.* In our case the oldest approximated groups are represented by $\alpha . A$; consequently we obtain for a further developed internode the following formula (the newly-formed groups being indicated by $\alpha . \beta \dots$):—

$$B . i . h . g . f . e . d . c . b . \alpha A .$$

The group α is in this case as far developed as the group i formed in regular sequence.

By further growth a secondary internode may be intercalated between $\alpha . A$, which, in its growth, behaves exactly like the primary internode, in so far as in it also the groups are new-formed in a proximal direction. At the same time, however, new bud-groups again appear, in accordance with the law above mentioned, between the oldest approximated groups of the primary internode, *i. e.* between b and α . We should therefore obtain, for a later stage, the following formula:—

$$B . k . i . h . g . f . e . d . c . b \alpha' a \beta \alpha A .$$

The latest formed bud-groups of the same size are here k , α' , and β .

These formulæ may easily be further developed, if we keep in our eye the law that new bud-groups always originate only between the oldest approximated groups of the primary internode, and that the intercalated secondary internodes, as well as the primary ones, form new groups in the proximal direction.

Only in one case I have also observed in the last internode of a very large *Halistemma* the rudiment of an intercalated tertiary internode (between α and A).

I may observe expressly that I have found the law of growth of the stem here developed to hold good without exception in all the specimens examined, and that the formulæ above given are taken from actual examples. When superficially examined, indeed, the last and longest internodes present a puzzling picture, and may give rise to the erroneous notion that the bud-groups have originated irregularly on the stem; but so soon as the regular plan has been recognized, it is extraordinarily pleasing to trace it through all the internodes of the elongated stem of a quietly suspended *Halistemma*.

I must leave it to Hæckel to say how such regularly ordered gemmation on the Physophorid stem is to be reconciled to his theory of the multiplication and dislocation of the Medusan organs on the Siphonophoran stock.

24. *Anthemodes canariensis*, Häck.

I observed a young specimen with six nectocalyces on the 21st of January.

25. *Crystallodes rigidum*, Häck.

The first specimen of *Crystallodes* occurred on January 12. From that date onwards this fine Physophorid appeared so regularly and so abundantly that it decidedly furnishes one of the most characteristic forms of the Canaries. Some specimens that I observed were in part considerably larger than the largest described by Häckel. Thus I not unfrequently captured animals of 75 millim. in length, with 24 complete nectocalyces and 9 individual groups. To complete Häckel's description, I may add that the larger examples presented 4-5 palps on each individual group, and that the male sexual racemes are placed proximally, the female ones distally. A further remarkable circumstance is that the perfectly mature male and female gonophores possess a well-developed umbrella, and are able by means of this to move in the water; moreover, in the perfectly mature sexual medusæ the manubrium does not project from the nectosac. Among the rigid bracts only those which are directly inserted upon the appendicular groups are provided with a long vascular canal; the internodial bracts, on the contrary, are destitute of the canal. Sometimes I found old examples of *Crystallodes* in which the stem was of a sulphur-yellow colour.

As regards the post-embryonic development of *Crystallodes*, I would chiefly call attention to the peculiarly formed larval tentacles. Häckel is of opinion that the cnidaria of the primary tentacle are directly developed into the definitive cnidaria furnished with a terminal vesicle and two lateral filaments. I was also the more inclined to this view because the larval cnidaria not only show the lateral filaments and terminal vesicle already observed by Häckel, but also present a mantle-like involucre, such as is actually characteristic of the definitive cnidaria. At any rate the cnidaria formed on the embryonal tentacles are considerably more complicated than those of any other Physophoridae, with their naked reniform batteries, which remind us of the Calycophoridae. Nevertheless they are not developed by spiral convolution of the urticating band into the definitive cnidaria, but they represent larval structures, followed in the later developed groups by heteromorphous structures. Thus I repeatedly observed full-grown old examples of *Crystallodes*, which still presented the well-

preserved larval tentacle upon the oldest gastric polype. Its cnidaria, as already mentioned, are furnished with a terminal vesicle, two terminal lateral filaments, and an involucre. However, they scarcely attain half the size of the definitive cnidaria, are of a very delicate reddish flesh-colour, and are without the spiral convolution of the urticating band.

Family *Forskaliidæ*, Hæckel.

26. *Forskalia ophiura*, Leuck.

The common *Forskalia* of the Mediterranean was also extraordinarily abundant at the Canaries from January onwards, occasionally occurring in gigantic examples, the nectostyle of which measured 1 foot.

As its larval tentacles are hitherto unknown I remark that in young specimens I found the single larval tentacle seated upon the oldest gastric polyp, while all the other polyps possessed the definitive tentacles. The cnidaria of the former resemble the larval batteries of *Agalma* and *Halistemma*; at the extremity they are beset with the uncommonly long sensorial setæ, and characterized by two lateral intensely brownish-red tubercles, projecting like ocelli, upon which long vibratile cilia are inserted.

27. *Forskalia contorta*, Leuck.

To *Forskalia contorta* I refer several young specimens, still furnished with larval tentacles, which occurred singly from January onwards. The larval cnidaria resemble those of *F. ophiura*, except that the sensorial setæ are shorter, and the two pigmented tubercles are wanting.

28. *Forskalia cuneata*, sp. n.

Subumbrella of the nectocalyces furnished on each side with 4-6 streaks of intensely bright red pigment. Gastric polyps remarkably large, standing in a very distinctly marked spiral turned to the right. Hepatic streaks reddish brown. Cnidarian knobs bright red. Bracts wedge-shaped, the outer surface truncated at right angles and completely filling up the interspace between the different spiral turns. Vascular canal of the bracts bent at a right angle.

The handsome *Forskalia cuneata* does not become so large as the allied species (it attains a length of 70 millim.), but it is not less remarkable by its vivid pigmentation and its particularly large gastric polyps. From the pigmentation of the subumbrella, which is never wanting, and is observable in no

other species, even the young stages, which are able to swim very briskly, are easily recognizable. In most of them the larval tentacle, seated upon the oldest gastric polyp, was still demonstrable. The larval batteries are very like those of *F. contorta*; they are acorn-shaped, of a faint red colour, and furnished with numerous short sensorial setæ. The subsidiary tentacle is inserted somewhat beneath the top of the battery.

Family Physophoræ, Lesson (*Discolabide*, Hæck.).

29. *Physophora magnifica*, Hæckel.

Of the splendid *Physophora* discovered by Hæckel at the Canaries a few examples occurred during February.

Family Anthophysidæ, Brandt (*Athorybide*, Huxley).

30. *Athorybia melo*, Esch., Q. & G.

To this species I refer some young specimens with only two tentacles and gastric polyps, which agree in the brownish pigmentation of the involucrum of the cnidaria (the terminal vesicle and lateral filaments are always present) and in the ridges of the bracts with the description given by Quoy & Gaimard. They occurred in February. To this species probably belong larval forms whose cnidaria on the single tentacle presented an involucrum and two lateral filaments, but no terminal vesicle. Moreover, the point of insertion of the subsidiary tentacle on the battery swells into a brown vesicular dilatation. The five bracts of these larvæ already resemble those of the full-grown *A. melo*; further, 5-6 palps may be recognized.

Tribe II. PNEUMATOPHORIDÆ, Chun.

Family Physalidæ, Brandt.

31. *Physalia caravella*, Esch.

I noticed the first *Physaliæ* at the end of January; from that date they occurred more and more abundantly, and after the violent storms in February and March they were thrown in thousands upon the beach. Upon their minute structure I will report elsewhere.

Suborder II. TRACHEOPHYSÆ, Chun.

Physophoridæ with a chambered pneumatophore lined with chitin, which emits numerous tracheal tufts surrounding the polyps. At the periphery of the pneumatophore a mantle-

like limb is developed. Stem flattened, disciform. Gonophores set free as Medusæ (*Chrysomitra*).

Family **Disconanthæ**, Häck. (*Chondrophoræ*, Cham. & Eysenh.), *Velellidæ*, Esch.

The representatives of the subfamilies of the Disconanthæ, namely the Velellidæ and Porpitidæ, appear at the Canaries, as I could ascertain from the statements of the fishermen, only in the summer from July to September. During the whole seven months of my stay I observed neither young forms (Rataria) nor developed *Velella* and *Porpita*. Even after the violent storms of spring I could not detect *Velella* and *Porpita* either near Orotava or in the passage to Palma and Gran Canaria. During the winter and early summer they appear to be wanting in the eastern part of the Atlantic Ocean.

XXIV.—*Descriptions of new Species of African Nymphalidæ.*
By W. F. KIRBY, F.E.S.

THE types of the following species are all in the collection of Mr. Henley Grose Smith, with the exception of that of *Euphædra* (?) *Crowleyi*, a very curious insect, which is the property of Mr. Philip Crowley.

Euphædra aureola.

Exp. $2\frac{3}{4}$ in.

Male.—Anterior wings velvety black, with a broad bluish line above the subcostal nervure, a moderately broad, oblique, orange-yellow band beyond the cell running from the subcostal nervure to the second median nervule, and a large patch of green scaling, coppery in the middle, on the inner margin, extending to three quarters of its length. The apical white patch is unusually narrow. Posterior wings bluish, with an indistinct coppery shade towards the costa beyond the cell; hind margin velvety black, with an indistinct broken submarginal line; inner margin dull brown or black, fringed with very long hairs. All the fringes black, with a long white spot at the apex of the anterior wings, and with four small white spots on the incisions on the anterior

wings and seven on the posterior wings. Underside varied with green and yellow; anterior wings with three spots in the cell (one at the base and two transverse spots in the middle) and two at the extremity of the cell, a long one surmounted by a small round one; just beyond the cell is another row of indistinct black spots. On the posterior wings the base of the costa is of a deeper orange than any other part of the wing, and there are two black spots in the cell and a third at the extremity. The borders of all the wings are green, edged on the inside with a row of long black spots between the nervures, and the white spots on the incisions are also surmounted by more or less distinct dusky spaces.

The face and lower orbits are silvery white, the palpi and under surface of the body are yellow, and the legs are brown, with the femora white beneath. The antennæ are black, with the shaft whitish, and the clubs yellowish at the joints beneath.

Hab. Cameroons.

Allied to *E. ravola*, Hew.

Euphædra (?) *Crowleyi*.

Exp. 2 in.

Male.—Orange-tawny, the costa and apical half of the anterior wings and the hind margins of all the wings black; a row of five white-spots (the third and fourth transverse) across the black apex of the anterior wings; the incisions white, and the border marked with a white loop at the anal angle of the anterior wings, and with at least four on the posterior wings. Under surface rather paler, and with more distinct white loops on the posterior wings.

Body black, spotted with white, and with a white stripe at the base of the abdomen above.

Hab. Agave.

Not closely allied to any known species, though several African butterflies and moths are very similar in colour.

Euryphene brunhilda.

Exp. $2\frac{1}{4}$ - $2\frac{3}{4}$ in.

Male.—Obscure olive-yellow, bordered with dark brown; costa greenish, the cells irregularly spotted with black, and three rows of connected black spots beyond, followed on the posterior wings by a continuous black stripe. Underside olive-brown, with a few dark lines in the cell of the anterior wings and with two rings and two dark lines in that of the posterior wings; the base of the costa, some transverse

markings in the cell of the anterior wings, and a row of irregular bluish-white markings beyond across all the wings; some whiter oblique markings towards the apex of the anterior wings; posterior wings varied with bluish white towards the anal angle.

Female tawny; anterior wings with the apical half brown, an irregular white blotch on the costa just beyond the middle, and a submarginal row of bluish-white spots, the larger ones centred with black, and the last of the series replaced by a black spot; posterior wings with a submarginal row of dusky markings, followed within by a row of obsolete dusky spots. Underside pinkish grey, with some indistinct annular markings in the cells, and the light markings of the upperside reproduced; a pale spot at the apex of the anterior wings, from below which a brown band curves inwards to the middle of the inner margin, and outwards across the middle of the posterior wings.

Hab. Cameroons.

Allied to *E. phranza*, *plautilla*, and *elpinice*, Hew.

Cymothoë serpentina.

Exp. $2\frac{3}{4}$ in.

Female brown, with irregular zigzag and annular markings in the cells; anterior wings with a row of white spots, only separated by the nervures running from the costa more than half across the wing, followed by two rows of sagittate white spots filled up with darker, and a row of less distinct white markings beyond; posterior wings traversed beyond the middle by a connected row of shallow lunules; beyond this is a row of conical blackish spots bordered within with paler; the extremities of the nervules of the posterior wings are marked with tawny. Underside purplish grey, paler towards the margins, the dark part of the wings bounded by a line beyond the transverse band of white spots; nearer the base are many annular and serpentine brown markings, and one zigzag line, which forms the inner boundary of the transverse band on the anterior wings, is continued across the posterior wings also; the pale marginal part of the wings is crossed by two irregular zigzag lines, the inner brown, the outer (which is incomplete towards the hinder angle of the anterior wings) shaded with chocolate.

Femora white (hind femora black above), the remainder of the legs and the palpi yellow.

Hab. Cameroons.

*Cymothoë seneca.*Exp. $2\frac{3}{4}$ in.

Male dark brown, crossed by a moderately broad common white band running from the middle of the costa on the anterior wings, where it is narrowest, to the anal angle of the posterior wings; this is followed by a double row of white spots, the innermost largest and sagittate; the outermost row commences on the anterior wings rather above the middle, but there is a larger white spot above it nearer the base and out of the series. Underside varied with white and grey, with numerous zigzag and annular markings near the base, and with an oblique common brown line, ill-defined towards the costa of the anterior wings. The outer part of the wings beyond the white band is dusky, with two ill-defined rows of whitish markings.

Hab. Cameroons.

Closely allied to *C. ciceronis*, Ward, but the white band is broader and the submarginal markings are less sharply defined.

*Cymothoë euthalioides.*Exp. $2\frac{1}{2}$ in.

Female brown, with black zigzag and annular markings in the cells, some of those on the posterior wings marked with tawny; the greater part of the wings beyond the middle whitish, with a double row of connected brown and blackish sagittate markings. Underside similar, but much paler, and consequently the markings towards the base better defined; a tawny line, straightest on the posterior wings, crosses the wings beyond the middle; the submarginal sagittate markings are more slender and better defined.

Hab. Cameroons.

Allied to *C. harmilla*, Hew.

XXV.—*The Staphylinidæ of Japan.*

By Dr. D. SHARP.

[Continued from p. 121.]

Group XANTHOLININA.

Baptolinus pilicornis.

Staphylinus pilicornis, Payk. Faun. Suec. iii. p. 380.

Nikko, August 1881; a series of seven examples.

Othius fulvipennis.

Pæderus fulvipennis, Fabr. Ent. Syst. i. 2, p. 537.

Hakone; one specimen only.

Xantholinus pauper, n. sp.

Angustus, brunneo-testaceus; elytris pedibusque testaceis; capite oblongo, opaco, crebre fortiter punctato; thorace crebre punctato, linea mediana lævigata.

Long. $5\frac{1}{4}$ millim.

Antennæ stout, with short scape, second and third joints moderately long, subequal, fourth to tenth transverse. Head obscure red, dull, coarsely punctate, the intermediate antennary grooves large and deep, the lateral grooves absent. Thorax slender, a little narrowed behind, a broad space along the middle smooth, but the sides distinctly and numerous though not densely punctured. Elytra not so long as the thorax, paler in colour than it, moderately closely and distinctly punctate.

This is a peculiar species, not well located in *Xantholinus*; but as it does not agree with any other genus, and its differential characters from *Xantholinus* are not very important, it is not desirable to treat it as a distinct genus at present. The terminal joint of the maxillary palpus is slender and about intermediate between that of *Xantholinus* and *Leptacinus*. The prothoracic pleura is of moderate size, not abbreviate, and its superior line is distinct; the front tarsi are simple, the middle coxæ moderately distant, the legs rather short, and the tibiæ spinulose.

Chiuzenji and Nikko, August 1881; one example from each locality.

Xantholinus tubulus, n. sp.

Subcylindricus, niger, nitidus; antennis, elytris pedibusque rufis; capite oblongo-ovali parce sat fortiter punctato; thorace seriebus dorsalibus circiter 10-punctatis.

Long. 7-8 millim.

Antennæ stout, second and third joints moderately long, subequal. Head black, very shining, impunctate along the middle, but with numerous rather fine punctures elsewhere. Thorax not slender, a little narrowed behind, black and very shining, with two rather irregular dorsal series of punctures, and with a strongly curved series on each side. Elytra about

as long as the thorax, pale red, rather finely and distantly punctured. Hind body rather rough. In one of the sexes of this species the terminal segment exhibits behind a quite circular orifice, the hind margin of which is lined internally by a ring of black, densely and regularly crenate, corneous substance.

Nikko and Miyanoshita ; three examples.

This is closely allied to *X. pleuralis*, but has the thorax more elongate and with smaller punctures, which are more numerous in the dorsal series ; the elytra are bright pale red and the head is a little narrower.

Xantholinus cunctator, n. sp.

X. lineari, auct., peraffinis ; nigricans, nitidus, vix subæneus ; antennis pedibusque rufis ; thorace crebre punctato, seriebus dorsalisibus haud discretis.

Long. 6 millim.

Antennæ with second joint elongate, considerably longer than the third. Head rather short, oval, sparingly punctate. Thorax oblong, with the lateral punctures numerous, the dorsal series being not separated from the lateral punctures. Elytra about as long as the thorax, shining, sparingly and rather strongly punctate.

This is very closely allied to the European *X. linearis*, but is rather smaller and has the third joint of the antennæ smaller, the head considerably shorter, and the thoracic punctures more numerous.

Only two examples have been found at Miyanoshita.

Xantholinus angusticeps, n. sp.

Niger, nitidus ; antennis pedibusque rufis ; capite angusto, ovali, parce subtiliter punctato ; thorace seriebus dorsalisibus circiter 12-punctatis, ad latera parce irregulariter punctato, punctis omnibus subtilibus.

Long. 6 millim.

Head elongate and narrow, considerably narrower than the thorax. Antennæ with the second and third joints rather slender, the latter the longer. Thorax rather slender, oblong, shining black, its punctures fine, consisting of two dorsal series of twelve punctures each, and the same number of lateral punctures on each side, these latter irregularly placed. Elytra with an indistinct brassy tinge, not quite so long as the thorax, rather sparingly and finely punctate.

This species has somewhat the appearance of the genus

Mitomorphus, Kr., but appears to be really an ally of *X. linearis*, auct., though the terminal joint of the maxillary palpi is somewhat slender.

Nagasaki, April 1881; a single example.

Xantholinus punctiventris, n. sp.

Angustus, haud depressus, nigerrimus, nitidus; pedibus, clytris antennisque rufis, his articulis primo et tertio nigris; capite ad angulos posteriores parce punctato: thorace tantum ad angulos anteriores utrinque puncto singulo notato.

Long. 9 millim.

This is another anomalous *Xantholinus*, having the facies of *Gauropterus*, but with the thoracic pleuræ not abbreviate; the last joint of the maxillary palpus is large, the anterior tibiæ are short and thick, their tarsi a little dilated, and the prosternum short, so that the insect appears to be really allied to the large *Eulissi* of South America. The third joint of the antenna is elongate, longer than the second. The head is oblong, convex, very shining black, with a few moderately coarse punctures near the sides and hind angles. Thorax narrowed behind. Elytra elongate and narrow, sparingly punctate in an irregularly seriate manner. Hind body remarkably coarsely punctured.

Ichiuchi, May 1st, 1881; a single example obtained by sweeping.

Leptacinus planulatus, n. sp.

Subdepressus, niger, nitidus: clytris piceis; antennis rufis, pedibus piceo-rufis; capite oblongo-quadrato, parum punctato; thorace seriebus dorsalibus obsolete circiter 4-punctatis.

Long. $4\frac{1}{2}$ millim.

Antennæ with short scape and small third joint only about half as long as the second, which itself is rather short. Head broad, but not so broad as long, straight at the sides and truncate behind, the intermediate antennal grooves obsolete, and the lateral or ocular ones present but very short, each being scarcely more than a very large puncture contiguous to the eye; the punctures are few and rather small. Thorax only slightly narrowed behind, the dorsal series consisting of four or five rather small punctures on each side, and besides these there are about the same number of still smaller punctures between the dorsal series and the lateral margin. Elytra longer than the thorax, almost impunctate.

This is an abnormal *Leptacinus*, on account of the obsolete frontal grooves.

Hitoyoshi, May 17th, and under bark of fir, Kuma Kuni, March 1881; one example from each locality.

Nudobius apicipennis, n. sp.

Subdepressus, nigerrimus, nitidus, pedibus rufis; antennis piceis, elytrorum apice testaceo-marginato.

Long. 8-9 millim.

Head oblong, closely and coarsely punctured. Thorax very shining, narrowed behind, and with the sides sinuate in the middle; the dorsal series of punctures are very distinct, consisting each of eight punctures, and there are also a few punctures near the side and front margin. Elytra longer than the thorax, shining black, with a faint blue or green tinge, and the hind margin yellow; finely and sparingly punctate. Underside of head coarsely punctate.

This species is allied to the European *N. collaris* and lives exclusively under bark; it was met with at Miyanoshta, Kiga, Kuma Kuni, Sendai, and Sapporo.

Subfam. *PÆDERINÆ*.

Group *LATHROBIINA*.

In this group I have established several new genera separated from *Lithocharis*, treating the eastern forms in a manner similar to that already applied to the Neotropical forms in the 'Biologia Centrali-Americana.'

Cryptobium cuneatum, n. sp.

Nigrum, nitidum; antennis fuscis, pedibus testaceis; capite angusto, dense fortiterque punctato; elytris thorace vix longioribus.

Long. 8-9 millim.

Antennæ infusate red, paler at the extremity. Head long and narrow, much narrower than the elytra, densely and coarsely punctate, the space between the antennal elevations much sculptured. Thorax long and narrow, not narrowed towards the front, moderately coarsely and not closely punctured, very shining, opalescent, a broad space along the middle impunctate. Elytra narrow, closely and rather coarsely punctate, a little shining. Male with a very shallow broad excision of the last ventral plate.

Though closely allied to *C. densipenne*, this is a narrower insect, readily distinguished by the narrower head, more sculptured in front, and the more shining wing-cases.

Konosè, Ogura lake, Otsu, Miyanoshita, and at Yokohama.

Cryptobium densipenne, n. sp.

Nigrum : antennis pedibusque testaceis ; elytris thorace paulo longioribus, densissime ruguloso-punctatis.

Long. 10 millim.

Antennæ unicolorous, yellow. Head elongate and narrow, a little narrower than the thorax, distinctly narrower than the elytra, densely and coarsely punctured, the punctuation scanty in front, the surface shining and very little sculptured between the antennal elevations. Thorax elongate and narrow, slightly narrower in front, very shining, black, coarsely and rather closely punctured, a line along the middle smooth. Elytra slightly longer than the thorax, dull, densely punctured, the punctures confluent, so as to give rise to a rugulose appearance ; the line on the inflexed side present, but fine. Male with a deep excision of the last ventral segment.

Closely allied to *C. japonicum*, but readily distinguished by the longer elytra and narrower head.

Miyanoshita, one pair ; Yuyama, one example.

Cryptobium japonicum.

Nikko and Miyanoshita ; four examples.

Lathrobium pollens, n. sp.

Piceum, nitidum : antennis pedibusque rufis ; capite brevi, subtriangulari ; elytris thorace fere duplo brevioribus.

Long. 10 millim.

Antennæ rather short and stout. Head short and broad, much narrowed in front, sparingly, moderately coarsely punctured, moderately shining ; eyes small. Thorax longer than broad, slightly narrowed behind, shining, nearly black, opalescent, rather sparingly punctured, with a broad space along the middle impunctate. Elytra very short, coarsely, somewhat sparingly, roughly punctured. Hind body rather broad, apex red. Front femora very thick. Male with a broad, shallow, rounded excision of the last ventral plate, the hind margin forming on either side of the excision a prominent

angle and bearing some short dark setæ; preceding segment with a much broader and shallower but otherwise similar excision.

Nagasaki, Nikko, Miyanoshita; in spring and early summer, six examples.

Lathrobium brachypterum, n. sp.

Piceum, nitidum; antennis pedibusque rufis; capite brevi, subtriangulari; elytris thorace fere duplo brevioribus.
Long. 8 millim.

This is very closely allied to *L. pollens*, but is a much smaller insect and more parallel; the head is much smaller and is quite sparingly punctured, the thorax is oblong, not at all narrowed behind, and the punctuation of the hind body is quite dense and fine. In the male the terminal ventral plate is not in the least emarginate, but its hind margin is slightly rounded, a broad space in front of this is slightly flattened and feebly granular; on the preceding segment there is a very obscure narrow impression just perceptible along the middle.

Nagasaki, Miyanoshita; five specimens.

Lathrobium monticola, n. sp.

Angustulum, piceum, nitidum; antennis pedibusque rufis; capite parvo, triangulari; elytris thorace duplo brevioribus.
Long. 7 millim.

Closely allied to *L. brachypterum*, but smaller and more slender, with more feeble antennæ, the head more triangular, and the eyes remarkably small; the elytra more sparingly and finely punctured and still shorter. The male is without positive sexual characters, but the hind margin of the last ventral plate is not produced and subacuminate as it is in the female.

This remarkable species is a mountain insect and was found near Nagasaki, April 11th, 1881; one pair.

Lathrobium carinicolle, n. sp.

Angustulum, subdepressum, nitidum, rufulum, dense punctatum; capite, thorace elytrorumque basi plus minusve fusco-obscuratis; thorace oblongo, medio linea arguta, subelevata, lævigata.
Long. 7-8 millim.

Antennæ red, rather elongate, penultimate joint longer

than broad. Head suborbiculate, quite as broad as the elytra, densely punctate, the punctuation on the vertex fine and extremely dense, on the anterior part coarser and more scanty. Thorax oblong, longer than broad, very densely coarsely punctured, a little shining, with a very conspicuous shining space extending all along the middle. Elytra scarcely so long as the thorax, parallel, shining, closely and coarsely punctured, with a very obscure linear arrangement of the punctures on the basal portion. Hind body extremely densely and finely punctured. Male with a broad shallow excision of the hind margin of the last ventral ring, and just in front of the middle of this a small patch of dense black asperities; the base of the segment exhibits a feeble depression along the middle.

Nikko, August; Nagasaki, June 1st; Kumamoto, April 25th.

L. anguinum is very closely allied to this species, but is more elongate, of a more uniform pallid colour, with a rather broader head, which has a definite smooth space on the middle, the elytra slightly longer, without any linear arrangement of the punctures. It has not been met with again.

Lathrobium cribricolle, n. sp.

Omnium fortissime dense punctatum, subcylindricum, nigrum, nitidum; antennis palisque rufis, pedibus flavis; elytris apice flavo-guttato.

Long. $6\frac{1}{2}$ millim.

Antennæ short and stout, penultimate joint a little longer than broad. Head oblong, excessively densely and coarsely punctured. Thorax oblong, rather longer than broad, shining black, remarkable on account of its excessively coarse punctuation, without smooth space along the middle. Elytra rather longer than the thorax, excessively coarsely punctured, each with a small yellow spot at the tip. Hind body entirely black. Male with a moderately broad and deep excision on the last ventral segment, and with a longitudinal depression extending along the middle of this and the preceding segment.

A very distinct species, to be placed near *L. nudum*.

Plain under Fujisan. Unique.

Lathrobium funebre, n. sp.

Angustum, elongatum, subdepressum, nigrum, nitidum, dense punctatum; pedibus fuscis, antennis tarsisque rufis; thorace linea mediana subelevata lævigata; elytris illo paulo longioribus.

Long. 7 millim.

Antennæ elongate, penultimate joint twice as long as broad. Head very densely punctate, on the middle and in front more sparingly and coarsely. Thorax narrow, much longer than broad, densely punctate, with a very definite smooth line along the middle. Elytra distinctly longer than the thorax, closely and coarsely punctate, flat, black, shining, a little red or piceous at the hind margin. Hind body extremely densely and finely punctate.

This is closely allied to *L. carinicolle*, but is a smaller, darker, more depressed insect, and differs in numerous details.

Morioka; one female.

Lathrobium cognatum, n. sp.

Subdepressum, nigrum; antennis palpisque fuscis, pedibus sordide flavis; crebre minus fortiter punctatum, capite minore; prothorace absque lineâ lævigata discretâ.

Long. 8 millim.

Antennæ slender, as long as head and thorax. Head small, much narrower than the elytra, very densely and finely punctate, the punctuation absent from only a very small space on the middle. Thorax rather longer than broad, distinctly narrower than the elytra, rather coarsely and closely punctate. Elytra rather longer than the thorax, closely subobsoletely punctured.

This is closely allied to the European *L. terminatum*, but has denser finer punctuation on the head and elytra, the latter being rather longer; the pale legs distinguish it from both *L. terminatum* and *L. quadratum*. The male characters are the same as they are in the two European species.

Chiuzenji, 24th August; six examples.

Lathrobium pallipes, n. sp.

Gracile, subdepressum, angustum, nigricans: antennis palpisque fusco-testaceis, pedibus flavis; elytris ad angulos externos flavo-maculatis; dense subtiliter punctatum.

Long. 6 millim.

Antennæ very long and slender, infusate yellow, with the base and apex more clear; palpi yellow, terminal joint infusate. Head small, very finely punctate, shining on the middle. Thorax slender, oblong, rather closely punctate, with a space along the middle smooth. Elytra closely and rather finely punctate, longer and broader than the thorax, with a very distinct yellow spot at the outer apical angle of each.

Hind body excessively densely and minutely punctulate, the extremity more pallid. Legs clear yellow. Male with a small rather broad excision on the terminal ventral plate and a very slight depression along the middle of the preceding segment.

This is another ally of *L. terminatum*, but is a very slender insect, only half the size of its European ally.

Yokohama, 7th April; Kioto, 2nd August; Niigata, 6th September; one example from each locality.

Lathrobium fragile, n. sp.

Angustius, subdepressum, nigricans, nitidum; thorace piceo; antennis palpisque fusco-testaceis, pedibus flavis; elytris thorace paulo longioribus, ad apicem macula magna flava.

Long. $5\frac{1}{2}$ millim.

This is closely allied to *L. pallipes*, but is a much more slender and parallel insect, and differs as follows:—the head is almost as broad as the elytra, suboblong; the thorax is piceous; the elytra are only about as long as the thorax and are more sparingly punctured, and have a larger yellow apical spot. The male has a very small and short, only just perceptible, excision of the hind margin of the last ventral plate, and a slight deplanation of the middle of the preceding segment.

Ogura lake, 7th July; five examples.

Lathrobium regulare, n. sp.

Parallelum, nitidum, nigrum; abdomine opaco; antennis pedibusque testaceis; thorace oblongo, dorso biserialim punctato, lateribus parce punctatis; elytris thorace brevioribus, parcius serialim punctatis.

Long. $6\frac{1}{2}$ millim.

A species of the *L. lusitanicum* group.

Antennæ rather slender and elongate; head suboblong, black, very shining, with irregularly placed, distant coarse punctures. Thorax oblong, straight at the sides, along the middle with two very regular series of punctures, ten or eleven punctures in each series, sides sparingly punctate. Elytra scarcely so long as the thorax, shining black, with a sutural series of punctures, then a rather broad smooth space, and outside this with three or four series of distant punctures. Hind body closely punctured, with a conspicuous fuscous pubescence. Male with a broad shallow excision of the hind margin of the last ventral plate.

Yokohama; six examples.

Lathrobium seriatum, n. sp.

Angustum, parallelum, nitidum, rufulum; capite elytrorumque angulis externis nigricantibus; antennis pedibusque testaceis; prothorace dorso biserialim punctato, lateribus disperse punctatis; elytris prothorace paulo longioribus, crebrius serialim punctatis.

Long. 6 millim.

Antennæ rather slender, moderately long. Head subquadrate, very shining, sparingly punctate, its upper surface more or less deeply tinged with black. Thorax longer than broad, straight at the sides, with the two series of punctures rather irregular and not very sharply distinguished from the lateral punctuation. Elytra a little longer and broader than the thorax, each with about six series of rather closely placed punctures; the outer hind angles obliquely black, the dark colour extending at the sides more than halfway to the front. Male with a very deep slender excision of the last ventral plate.

Yokohama; two examples. This species occurs also in China, and was taken there by Mr. Lewis near Kiu Kiang in 1864.

Lathrobium monilicorne, n. sp.

Subeylindricum, nigerrimum, nitidum; antennis, palpis tarsisque rufis, pedibus fuscis; capite parvo fortiter punctato; antennis crassiusculis; palpis articulo terminali crasso.

Long. $6\frac{1}{2}$ millim.

Antennæ short and stout, dark red, and moniliform, the penultimate joint scarcely longer than broad. Head small, suboblong, much narrower than the thorax, coarsely, not densely punctate. Thorax longer than broad, suboblong, a little narrower in front, coarsely, not densely punctate, with a smooth line along the middle. Elytra elongate and narrow, longer than the thorax, shining, coarsely, irregularly, rather closely punctured. Hind body rather coarsely punctate.

A peculiar species, probably entitled to generic distinction, the neck being more slender than usual, the pseudo-terminal joint of the palpi remarkably thick; the hind tibiæ but little incrassate and with their oblique truncation diminished; the tarsi more slender than usual. At present to be placed near *L. punctatum*.

Two females; taken in the plain of Fujisan in April 1880.

Domene daimio, n. sp.

Nigra; elytris, antennis pedibusque fusco-rufis; capite thoraceque densius fortiusque punctatis, illo subovali.

Long. $12\frac{1}{2}$ millim.

Antennæ elongate, penultimate joint much longer than broad. Head elongate, very densely and coarsely punctured, not quite dull. Thorax oblong, very coarsely and densely punctured, a little shining. Elytra as long as the thorax, rufescent, darker at the base, densely punctured. Legs obscure red, femora darker. Male with the hind margin of last ventral segment sinuate-emarginate and in the middle with a rather small excision; in front of this a small depression densely set with black asperities; the preceding segment very slightly impressed.

This fine insect is larger than *D. crassicornis* and readily distinguished by the long antennæ and narrow head; the shape of the hind margin of the last ventral segment in the male is peculiar.

Miyanoshita, May 1880; one example.

Domene crassicornis.

Lathrobium crassicorne, Sharp, Trans. Ent. Soc. Lond. 1874, p. 59.

The male has a large sharply defined excision of the last ventral segment and in front of this a rather broad depression studded with fine black asperities; the preceding segment bears a slight but broad depression.

Apparently scarce; Miyanoshita and Yuyama in May, Kobé in June.

Domene orbiculata, n. sp.

Latiuscula, fusca; capite thoraceque nigricantibus; antennis rufis, pedibus testaceis; elytris thorace multo brevioribus, fusco-æneis; capite thoraceque densissime subtiliter sculpturatis, illo orbiculato.

Long. 10 millim.

This is readily distinguished from *D. curtipennis* by the broader form and the denser finer sculpture of the head and thorax; the antennæ are much larger, being both longer and thicker.

Chiuzenji, 22nd August, 1881; one female, under dead leaves.

Domene curtipennis, n. sp.

Nigra, angustula; antennis rufis, pedibus testaceis; elytris fusco-
aeneis; thorace haud longioribus.

Long. $6\frac{1}{2}$ – $7\frac{1}{2}$ millim.

Head suborbiculate, very densely, rather coarsely sculptured, quite dull. Thorax longer than broad, very densely, rather finely, rugosely sculptured. Elytra about as broad as the thorax and not longer than it, of a dusky reddish colour, with a strong brassy tinge, rather shining, densely moderately finely punctured. Hind body black or piceous, paler at the extremity. The male has a very small excision at the extremity of the last ventral segment and in front of it a narrow elongate depression studded with black granules; the preceding segment has a well-marked, large, but not deep depression.

Closely allied to *D. stilicoides*, but smaller, with shorter and narrower elytra, more orbiculate head, and shorter metasternum. Also very similar to the European *D. scabricolle*, but more finely sculptured, the elytra not narrower at the shoulders, and the male characters different.

Yokohama, April; Nikko, June; Chiuzenji, 22nd August; rare.

Domene stilicoides.

Lathrobium stilicoides, Sharp, Trans. Ent. Soc. Lond. 1874, p. 58.

The male is still unknown; the two examples found during his recent expedition by Mr. Lewis are both females.

Ichiuchi, 30th April, 1881, under dead leaves in a hollow tree.

Scopæus currax, n. sp.

Angustulus, elongatus, haud depressus, rufescens; antennis pedibusque testaceis; elytris fuscis, apicem versus flavis, prothorace paulo longioribus.

Long. 4 millim.

Antennæ clear yellow, slender and elongate, penultimate joint considerably longer than broad. Head narrow and elongate, but little emarginate behind, dull, very densely and finely punctate. Thorax subovate, longer than broad, but little narrower than the elytra, rather shining, almost imperceptibly punctate, with a short carina on the middle behind. Elytra long and narrow, densely punctate, dull, fuscous, with the apical third of the length yellow.

This insect is allied to the European *S. Erichsonii*, from which, however, it is abundantly distinct. Although no males have been found, it is so different from the other Japanese species that no difficulty will be found in identifying it. It is rather longer than *S. Erichsonii* and less depressed; it is more elongate, the head especially being more elongate and narrower in front.

Yokohama, Niigata, and Nikko; four examples.

PANSCOPEUS, nov. gen.

Caput collo angustissimo. Labrum medio excisione parva utrinque denticulo parvo instructa. Prothorax pentagonalis: prosternum processu supracoxali abbreviato. Tarsi graciles, anteriores haud dilatati, posteriores filiformes, articulo basali quam secundo duplo longiore.

This genus agrees with *Scopæus* in the very slender neck, but in other respects it is nearer to *Lithocharis*, next which it should be placed, though it is well separated by the form of the head and thorax. On each mandible one tooth only can be seen, but the basal portion of the mandible is incrassate inwardly and slightly notched, so as to represent on the left side two, on the right three, rudimentary teeth. The slender and linear hind tarsi are quite different from the feet of *Scopæus* and agree better with *Lithocharis*.

Panscopæus lithocharoides.

Scopæus lithocharoides, Sharp, Trans. Ent. Soc. Lond. 1874, p. 63.

This species has been found in several localities on the main island; Biwa Lake and Nikko.

CHARICHIRUS, nov. gen.

Labrum magnum, medio fortiter dentatum, utrinque subsinuatum. Caput collo angusto; prosternum processu supracoxali abbreviato. Tarsi omnes graciles, anteriores simplices, posteriores articulis quatuor basalibus longitudine gradatim decrescentibus, articulo secundo elongato, quam quarto plus duplo longiore.

This insect has more the appearance of *Medon* than of *Lithocharis*, but cannot be placed in the former genus on account of the abbreviated prosternal process; from *Lithocharis* it is well distinguished by the structure of the labrum, which has a large tooth in the middle; the neck, too, is a little broader and the second joint of the hind foot much

longer relatively when compared with the fourth. The only species, so far as I know, is the following.

Charichirus spectabilis.

Lithocharis spectabilis, Kr. Arch. f. Naturg. xxv. p. 134.

This may perhaps have been introduced into Japan, as it is apparently rare there, though widely distributed in the eastern and southern parts of Asia.

ISOCHEILUS, nov. gen.

Labrum fere simplex; mandibulæ tridentatæ. Caput collo medio-criter angusto. Tarsi anteriores leviter dilatati, posteriores articulis quatuor basalibus gradatim decrescentibus. Prosternum processu supracoxali brevi.

This genus undoubtedly comes very close to the New-World *Aderocharis*, and its unique species has quite the appearance of the genus last named; nevertheless I think the two are better separated. The labrum in *Isocheilus* when mounted in balsam is seen to be divided nearly to the base by a deep abrupt excision, which, however, is filled up by a horny process, the front margin of which does not extend quite so far forward as the lateral portions, whereas in *Aderocharis* the excision is much narrower and the front of the labrum is most prominent in the middle, being in fact distinctly dentate. Each mandible in *Isocheilus* is tridentate, while in *Aderocharis* the right mandible is quadridentate. The very short prosternal process is one of the most important characters of *Isocheilus*. The genus at present has only one species, viz.:—

Isocheilus staphylinoides.

Lithocharis staphylinoides, Kr. Arch. f. Naturg. xxv. p. 135.

Not uncommon in Japan. I have not seen specimens from Ceylon, the locality of the examples described by Kraatz.

Thinoharis basicornis.

Scopæus basicornis, Sharp, Trans. Ent. Soc. Lond. 1874, p. 63.

This minute insect is perhaps not rare, though its small size will probably render its capture somewhat unfrequent. Mr. Lewis has brought back only three or four examples. It is probably a *Thinoharis*, though this is by no means cer-

tainly ascertained, as I have seen no insect from Ceylon or any other locality than Japan that I can assign to the genus, and the trophi have not been dissected.

MEDON.

This genus, as I have pointed out elsewhere in confirmation and amplification of the views of Thomson and Rey, is quite distinct from *Lithocharis*. Most of the Japanese species of it are, however, dissimilar in appearance from the European forms, and some of them will probably prove generically distinct.

Medon rubeculus, n. sp.

Angustulus, densissime subtilissime punctatus, subopacus, nigricans : elytris, antennis pedibusque dilute rufis.

Long. $4\frac{1}{2}$ –5 millim.

Antennæ slender, third joint about equal in length to the second, slightly more slender than it, penultimate joint not so long as broad. Head subquadrate, very finely and densely punctured, quite dull. Thorax subquadrate, densely, very finely punctate, without any definite smooth line along the middle, very feebly canaliculate in the middle behind. Elytra longer than the thorax, dilute red, with the base infuscate, densely and finely punctate. Legs slender, hind tarsi quite slender.

Iwaki and Sapporo; two badly preserved females. Though I have not been able to see the structure of the mandibles and labrum, I do not doubt this being a *Medon*. It bears a considerable resemblance to *M. prolixus*, but possesses very different feet.

Medon Lewisius.

Lithocharis Lewisia, Sharp, Trans. Ent. Soc. Lond. 1874, p. 65.

Nagasaki, Yokohama, Miyanoshta, Ichiuchi, Iitoyoshi, Hakone, Nikko. All the examples have been found under bark, so that the occurrence of the example originally described on the sea-shore was no doubt merely accidental. I have not detected any sexual characters. The colour of the head and thorax varies from dark red to black.

Found in many localities, Nikko being the most northern point.

Medon confertus, n. sp.

Fusco-rufus; capite, thorace elytrisq[ue] nigricantibus; abdomine ante apicem nigro-variegato; antennis rufis, pedibus flavis; opacus, capite thoraceq[ue] densissime subtiliter subrugose punctatis, hoc medio angustissime carinulato.

Long. 5 millim.

Rather narrow. Antennæ red, the middle joints slightly darker, penultimate joint not quite so long as broad. Head quadrate, excessively densely punctured, so as to be dull, the punctuation only moderately fine. Thorax subquadrate, but little broader than long, its punctuation even denser and finer than that of the head, with a very fine smooth line along the middle. Elytra rather long, a good deal longer than the thorax, densely and finely punctate, slightly shining. Hind body red at the base, the apical segments black, but the black colour is interrupted by the hind margin of the penultimate and the base of the terminal segments being red.

I can see no character foreign to *Medon* in this species except that the anterior tarsi are a little more dilated than is usual.

Yuyama and Hitoyoshi, May 1881; five examples.

Medon spadiceus, n. sp.

Depressus, latiusculus, fuscus; capite nigro; elytris sordide testaceis; antennis rufis, pedibus testaceis; capite thoraceq[ue] fortiter punctatis, hoc medio profunde canaliculato.

Long. 5 millim.

Antennæ red, rather stout, slightly thicker externally, penultimate joints very distinctly transverse. Head broad, subquadrate, slightly narrowed in front, densely and very coarsely punctate, with a smooth line along the middle in front. Thorax transverse, a little narrowed behind, coarsely and closely punctate, obscure black in the middle, obscure red at the sides, with a very distinct channel along the middle. Elytra a little longer than the thorax, shining, somewhat sparingly punctate, the extremity yellow, the base infusate yellow.

This is apparently a very distinct species and will readily be recognized by the deep channel on the thorax. It is sufficiently distinct from *Medon* to be generically separated, the basal tooth on the right mandible being only obscurely divided and the hind tarsus short, with the four basal joints subequal in length.

Unique. Chiuzenji, 19th August, 1881.

Medon discedens, n. sp.

Subdepressus, elongatus, picco-niger, nitidus; antennis pedibusque rufis, illis gracilibus; capite thoraceque irregulariter, minus dense, fortiter punctatis.

Long. 6-6½ millim.

Antennæ slender and elongate, penultimate joint quite as long as broad. Head large, shining, black, coarsely, rather sparingly punctate, more sparingly on the middle. Thorax strongly transverse, much narrowed behind, coarsely punctate, quite shining. Elytra rather longer than the thorax, with a close, rough, rather coarse sculpture. Hind body moderately closely granulose punctate. Hind tarsi quite slender, basal joint twice as long as the third.

This is another peculiar, very distinct species. The labrum is divided in the middle nearly to the base by a deep angular excision, on either side of which there is a very slight projection; the front tarsi are scarcely dilated; the teeth of the mandibles are large and there is on either side one less than normal; the left mandible is only bidentate, but the large basal tooth is bidentate at the extremity; the right mandible is tridentate.

Kiga and Miyanoshita.

Medon submaculatus, n. sp.

Testaceus; capite abdomineque ferrugineis, hoc ante apicem fusconotato; elytris ad latera plus minusve argute nigro-maculatis.

Long. 4½ millim.

Head not large, finely, extremely densely punctate, dull. Thorax transversely subquadrate, slightly narrowed behind, densely, rather finely rugose-punctate, with a smooth line along the middle, becoming obsolete in front. Elytra densely and finely punctate, with a dark mark, frequently obsolete, on the middle of the side of each. Hind body very finely punctate, the antepenultimate dorsal plate infusate. Front tarsi strongly dilated; hind tarsi quite slender, basal joint twice as long as the second. Male with a broad shallow excision on the hind margin of the last ventral plate.

This is another peculiar species with strongly dilated front feet and unusually small teeth on the mandibles.

Sandy river-banks, Niigata, Kashiwagi, Nagasaki.

Medon proluxus.

Lithocharis proluxa, Sharp, Trans. Ent. Soc. Lond. 1874, p. 65.

The nearest ally of this species is the European *L. mari-*

tima, Aubé. I think the two might well form a distinct genus on account of the *Scopæus*-like structure of the feet.

Local; under seaweed, Mississippi Bay, Yokohama.

Lithocharis ochracea.

Pæderus ochraceus, Grav. Col. Micr. p. 59.

Mr. Lewis has obtained at Nagasaki and Yokohama a few individuals which I think belong to this species; unfortunately they are all females, and the determination is a little uncertain, *L. parviceps* being so extremely like this species that the two can only be certainly distinguished by the male characters.

Lithocharis dissimilis.

Lithocharis dissimilis, Sharp, Trans. Ent. Soc. Lond. 1874, p. 66.

This species has not been found again; there is little doubt that it will form a new genus near *Scioporus*, but it would be scarcely possible to ascertain the characters sufficiently without too great a manipulation of the unique example.

[To be continued.]

XXVI.—Notes on the Genus *Melapium*, H. and A. Adams.

By EDGAR A. SMITH.

THIS genus of Mollusca was founded by Messrs. H. and A. Adams* for the reception of the *Pyrula lineata* of Lamarck, a species which appeared to them, even on conchological grounds alone, generically distinct from *Pyrula*. An examination of the animal, which I have been able to make through the kindness of Mr. J. H. Ponsonby, confirms the correctness of their judgment. The animal may be described thus:—

Foot oval, rather high, not truncate or biemarginate in front, in length about one and a half times the width, pale beneath, bordered all round above the margin with two bright red lines about 2 millim. apart. *Head* small, compressed. *Tentacles* 5 or 6 millim. long, acutely tapering. *Eyes* minute, at outer base of tentacles, on slight prominences. *Penis* compressed, 10 to 12 millim. in length, obtuse at the end. *Siphon* shortish, moderately acuminate. *Branchiæ* in two plumes, the

* Genera Moll. vol. i. p. 136.

right large, the left small. *Operculum* none. *Odontophore* (see fig.) most resembling that of *Rapana bulbosa* as figured by Troschel ('Gebiss der Schnecken,' vol. ii. pl. xiii. fig. 13), consisting of a single tricuspid central tooth and a single acute curved lateral. The central tooth is transversely elongate and the cusps are nearly equal in size, short, acute, and approximated.



From the above description (taken from spirit-specimens) it will be seen that, with the exception of the odontophore and the absence of an operculum, there is a general resemblance to *Buccinum*.

The systematic position of *Melapium* has naturally been variously determined. H. and A. Adams placed it in the subfamily Rapaninæ of the Buccinidæ, between the genera *Separatista* and *Rapa*. Tryon located it in the same position, omitting the subfamily Rapaninæ, which he included in the Purpurinæ. Kobelt unites it with the genus *Rapana*, and Fischer* places it near *Tudicula* in the Turbinellidæ.

After due consideration I believe its correct position to be between *Rapana* and *Coralliophila*.

There are two species of this genus at present known. They have been confounded by most authors, with the exception of Sowerby.

The first species described was the *Pyrula lineata* of Lamarck. This I believe to be the smaller South-African species (= *bulbus*, Wood, also) and not the larger form figured by Kiener, Reeve, Chenu, Tryon, and Kobelt, which is undoubtedly the *Pyrula elata* of Schubert and Wagner.

Lamarck's description applies in every particular to the smaller form, but *not* to the larger. The size ("13 lignes") and the colour of the columella ("alba") certainly indicate the South-African species, and no mention is made of the prominent acute keel around the cauda of the body-whorl, a feature so marked that Lamarck could hardly have failed to notice it had it existed in the shell before him.

To a great extent Kiener must be held responsible for the confusion which has hitherto existed with regard to these two species.

In order to make Lamarck's diagnosis (which he quotes) agree with the shell he figured under the name of *P. lineata*, he made an alteration, the columella being described as "albo-violacea" instead of "alba." This was scarcely straight-

* Journ. de Conch. 1884, vol. xxxii. p. 10; Man. Conch. p. 620.

forward, as in most instances he quoted Lamarck's descriptions intact.

However, the shell figured by him certainly was not the type of the species, the size (2 inches) at once settling that point.

I have seen a number of the true *M. lineatum*, and none have exceeded the dimensions given by Lamarck.

Besides the differences mentioned by Sowerby *, I would point out that the brown lines in *M. elata*, besides being "broader and more distant," are not continued up to the suture nor so near to the basal extremity as in *M. lineata*, the latter also (as in Krauss's specimen) usually exhibiting some dark spots around the body-whorl a little above the middle.

The synonymy of the two species is as follows :—

Melapium lineatum (Lamarck).

1822. *Pyrula lineata*, Lamarck, Anim. s. Vert. vol. vii. p. 147 ; (Deshayes), ed. 2, vol. ix. p. 520 (1843).

1828. *Buccinum bulbus*, Wood, Index Test., Suppl. p. 12, pl. iv. fig. 8.

1848. *Pyrula lineata*, Krauss, Sudafr. Moll. p. 111.

1858. *Melapium lineatum*, H. & A. Ad. Genera Moll. vol. iii. pl. xiv. fig. 7.

1886. *Melapium bulbus*, Sowerby, Journ. Conch. vol. v. p. 6.

Hab. Cape of Good Hope (*Krauss & Brit. Mus.*) ; Port Elizabeth (*Sowerby*).

Melapium elatum (Schubert and Wagner).

1829. *Pyrula elata*, Schub. & Wagn. Conchyl. Cab. vol. xii. pp. 92 and 94, pl. ccxxvi. figs. 4012-4013.

1840. *Pyrula lineata*, Kiener (non Lamarck), Spec. Coq. Viv. p. 24, pl. xv. fig. 1.

1847. *Pyrula lineata*, Reeve (non Lamk.), Conch. Icon. vol. iv. pl. viii. fig. 28.

1859. *Melapium lineatum*, Chenu, Man. Conch. p. 173, fig. 855.

1878. *Rapana lineata*, Kobelt, Illustr. Conchylienbuch, p. 52, pl. xv. fig. 2.

1880. *Melapium lineatum*, Tryon, Conch. Man. vol. ii. p. 213, pl. lxvii. fig. 395.

1883. *Melapium lineatum*, Tryon, Syst. Conch. vol. ii. p. 400, pl. xlv. fig. 50.

Hab. Indian Seas (*Kiener*).

The above probable locality must be accepted with reserve until it receives confirmation.

* Journ. of Conch. vol. v. p. 6.

XXVII.—*Description of a new Genus of Parasitic Mollusca.*
By EDGAR A. SMITH.

ABOUT a year ago the British Museum purchased of Mr. Robillard, of the Mauritius, among other specimens, a single example of a shell, which, according to his statement, appears to have been "found living on an *Echinus*." This specimen I have been unable to locate in any known genus of parasitic Mollusca.

The number of genera which may be truly said to be parasitic appears to be very small.

Stilifer lives a parasite upon Echini or in the skin or tegument of starfishes. Some species of *Eulima* are found in Holothurians, the abode also of the curious *Entoconcha*. *Styliferina* occurs on species of Ophiuridæ.

Stimpson has named a parasitic mollusk *Cochliolepis parasiticus* which lives beneath the scales of an Annelid (*Acoëtes lupina*). Many species of *Ovula* are found only upon *Gorgonia*; *Capulus crystallinus* infests the rays of starfish; one or two species of *Odostomia* are said to occur on *Pecten*; the little *Pedicularia* lives parasitic upon corals &c.; and the species of *Rhizochilus*, *Coralliophila*, *Cryptobia*, *Leptoconcha*, and *Magilus* are invariably found in or upon corals, but to what extent they may be regarded as truly parasitic has not as yet been determined. The female of *Lamellaria perspicua* is said to deposit its eggs in a compound Ascidian (*Leptoclinum*). A few species of bivalves are known to be parasitic. *Lepton parasiticum*, Dall, lives upon a sea-urchin (*Hemiaster cavernosus*). A species of *Montacuta* is "invariably found attached to the spines of *Spatangus purpureus* and other Echinoderms of the same kind." *Modiolaria marmorata* burrows into the test of Ascidians, and the genera *Vulsella* and *Crenatula* live in sponges. *Pedum* and *Tridacna* and some species of *Lithodomus* occur in corals; but these can scarcely be considered parasitic forms. The glochidium-stage of *Anodonta* is truly parasitic, obtaining nourishment from the fish to which it has become attached.

The species under consideration bears only a general resemblance in form to one of those which I have mentioned, namely *Cochliolepis parasiticus* *. As its conditions of life are so different, there is little doubt but that it is generically quite distinct, and I therefore propose to describe it as such under the name *Robillardia*. Its systematic position is

* Stimpson, Proc. Bost. Soc. Nat. Hist. 1888, vol. vi. p. 308, woodcut.

very doubtful at present, the animal being unknown. A small dried portion of it was attached to the shell, but no odontophore could be discovered in it. Some minute, glassy, grain-like objects adhering to it proved on examination under the microscope to be minute shells and doubtless the young of this species; there is therefore every reason to believe that it is viviparous.

The genus and species may be described thus:—

ROBILLARDIA.

Animal parasiticum, *Echinus* incoleus, viviparum. Testa vitrea, depresso helici-formis; spira brevis; apertura lunata, magna; peristoma simplex, tenue.

Robillardia cernica *.



Testa tenuis, pellucida, vitrea, nitens, imperforata, depresso globosa; anfractus 5 celeriter crescentes, lirulis sulcisque levibus spiralibus striisquo incrementi arcuatis sculpti, convexi, sutura canaliculata sejuncti; ultimus magnus, ad peripheriam rotundatus, inferne concentrico leviter liratus et scrobiculatus, in regione umbilici plus minus tenuiter callosus; apertura lunata; peristoma tenue, margine inferiore recedente, columellari supra leviter expanso.
Diam. maj. 8 mm., min. $6\frac{1}{2}$; alt. 5.

Hab. Mauritius.

This delicate shell has the glassy texture of *Carinaria* and somewhat the form of certain species of *Hyalinia*.

XXVIII.—Synopsis of the *Rhynchotal* Genus *Plisthenes*.

By W. L. DISTANT.

THIS genus of Tesseratominæ, founded by Stål in 1864, is liable by the large size and general resemblance of its representatives with their almost common area of distribution to have its different species unrecognized. This was absolutely the case with Stål, who, in enumerating the genus (En. Hem. i. p. 63), included the second species, *P. dilatatus*, Montr., more fully redescribed by Vollenhoven, as a synonym of *P. Merianæ*, Fabr. I was subsequently (Trans. Ent. Soc. 1880,

* From "Cerne," an old name of the island of Mauritius.

p. 151), by the acquisition of specimens, enabled to structurally and otherwise separate these two species, and am now, by the possession of three examples from South-west New Guinea, received through Mr. E. P. Collett from Mr. J. C. Melvill, in a position to add a third species to the genus. The following is a rough synopsis of the same:—

- Scutellum unicolorous and with the lateral margins straight and not distinctly sinuate near apex.
 Sternal spine not reaching anterior coxæ.
 Antennæ with the second joint considerably shorter than the third.
 Abdomen beneath with a central, longitudinal piceous fascia *P. Merianæ*.
 Sternal spine reaching anterior coxæ.
 Antennæ with the second joint very little shorter than the third.
 Abdomen beneath with a central and two sub-marginal piceous fasciæ *P. dilatatus*.
 Scutellum with the apex ochraceous and with the lateral margins distinctly sinuate near apex..... *P. scutellatus*.

Plisthenes scutellatus, n. sp.

Allied to *P. dilatatus*, but differing by having the lateral margins of the scutellum distinctly sinuate near apex, which is broadly ochraceous, with the tip black. The second and third joints of the antennæ are almost subequal in length, and the apex of the third joint is ochraceous (fourth joint mutilated). The sternal spine about reaches the anterior coxæ, as in *P. dilatatus*.

Long. 28 to 33 millim.

Hab. South-west New Guinea (*J. C. Melvill*).

The three species vary very much in the size of their representatives, and *P. Merianæ* in the colour of the antennæ, which in typical examples have only the last joint ochraceous, whilst in some Australian specimens, as pointed out by Stål, and in some from Murray Island, as already described by myself, both the third and fourth joints are ochraceous.

The following are the localities of the specimens in my own collection:—

P. Merianæ, Fabr.—Amboina, Torres Straits, Port Moresby, Murray Island.

P. dilatatus, Montr.—Port Moresby, Celebes.

P. scutellatus, Dist.—South-west New Guinea.

XXIX.—On "Aulacochelys," Lydekker, and the Systematic Position of *Anosteira*, Leidy, and *Pseudotrionyx*, Dollo.
By Dr. G. BAUR, New Haven, Conn.

In the January number of this Journal Mr. R. Lydekker* established a genus *Aulacochelys* for *Trionyx circumsulcatus*, Owen.

The character of this genus consists in the "presence of a deep groove in the free border of the costals," and in this it is said to differ "from all species of *Trionyx*."

At first we may ask, Is a groove in a portion of a dermal ossification of generic value? and may safely answer that it is not.

Such a groove is very common at the outer end of the united hyo- and hypoplastra in the *Trionychidæ*; and this fact alone contradicts the generic value of such a structure. This groove may be present or absent in the same species; it is generally present in old individuals. But if we find it even on the pleuralia (costals) of living *Trionychidæ*, it is simply individual and without any systematic value whatever. In old specimens of *Aspidonectes ferox*, Schn., and of *Aspidonectes muticus*, Les., this groove is very well developed. In other specimens of the same species and different *Trionychidæ* I find no trace of it.

The genus *Aulacochelys*, Lydekker, therefore is not entitled to recognition as being based upon such trivial characters.

In the same paper a new species of *Anosteira* is proposed and named *A. anglica*. It is based on one anterior marginal and a xiphiplastral. This form cannot be distinguished from the *Anosteira radulata*, Cope †, described in 1871 and figured in Prof. Cope's ‡ well-known work on the Vertebrata of the Tertiaries of the West.

It seems that Mr. Lydekker was not aware of the existence of another species of *Anosteira* except Leidy's type.

In the same number of this Magazine § I have remarked that *Anosteira* belongs either to the *Staurotypidæ* or *Cino-*

* Lydekker, R., "Preliminary Notice of new Fossil Chelonia," Ann. & Mag. Nat. Hist. Jan. 1889, p. 53.

† Cope, E. D., "Descriptions of new Extinct Reptiles from the Upper Green River Eocene Basin, Wyoming," Proc. Am. Phil. Soc. vol. xii. Jan. 1871-Dec. 1872: Philadelphia, 1873 (paper published Oct. 12, 1871).

‡ Cope, E. D., 'The Vertebrata of the Tertiary Formations of the West,' Book I., Washington, 1883 (published Jan. 1885), p. 128, pl. xviii. figs. 18, 19.

§ Baur, Dr. G., "The Systematic Position of *Meiolania*, Owen," Ann. & Mag. Nat. Hist., Jan. 1889, pp. 58, 59.

sternidæ. I now give a more detailed account of my reasons. When Prof. Leidy * gave the first notice of this interesting fossil he said :—"None of the plates exhibit scute impressions, generally so evident in the Emydes." But in his full description he states † :—"A few of the plates exhibit obscure lines, but I am uncertain as to whether they accord with the areas of the scutes."

Prof. Leidy does not give to *Anosteira* a definite position in the system. Prof. Cope ‡ places the form among the Chelydridæ, and observes :—"This genus must be regarded as an interesting intermediate type connecting *Pleistomenus* and *Chelydra* or *Dermatemys*. In skin and sculpture it is identical with the first, in carapace and plastron most like *Chelydra*" (p. 127). This view is adopted by Dollo §, who places *Anosteira* together with his *Pseudotrionyx* among the Chelydridæ.

Lydekker, in some notes on this paper, held the opinion that *Pseudotrionyx* might perhaps be referred to the Trionychidæ (Geol. Mag. 1886, p. 521); but this view was abandoned in 1887, when Boulenger and Lydekker|| declared that it may probably be regarded as belonging to a distinct family from the absence of epidermal shields. This family was called the Pseudotrionychidæ by Boulenger ¶, containing *Pseudotrionyx* and *Anosteira*, and placed near the Cinosternidæ.

The absence of dermal scutes seems to be generally admitted. But in fact they are not entirely missing. The marks observed by Leidy are really marks produced by the impression of scutes. They are well shown at the posterior peripherals (marginals), and especially on the pygal, in a specimen of *Anosteira ornata*, Leidy, in the Yale College Museum. I could not find any marks on the plastron; but it seems probable that scutes existed all over the shell. The impressions on the plastron of the Cinosternidæ, particularly in *Monochelys odorata*, are already insignificant.

I have shown (Osteol. Notizen über Reptilien, Fortsetzung vi.) that the Staurotypidæ and Cinosternidæ are the only known living Testudinata which have ten peripherals, eight

* Proc. Ac. Nat. Sci. Philad. 1871, pp. 102, 103.

† Leidy, Joseph, 'Contributions to the Extinct Vertebrate Fauna of the Western Territories,' Washington, 1873, p. 175.

‡ Cope, E. D., 'The Vertebrata of the Tertiary, &c.,' p. 112.

§ Dollo, L., "Première note sur les Chéloniens du Bruxellien (Éocène Moyen) de la Belgique," Bull. Mus. Roy. Hist. Nat. Belg. tome iv. 1886, p. 96.

|| Lydekker, R., and G. A. Boulenger, "Notes on Chelonia from the Purbeck, Wealden, and London Clay," Geol. Mag. June 1887, p. 274.

¶ 'Encyclopædia Britannica,' 9th ed. vol. xxiii. 1888, p. 457.

of which (three to ten) are connected with the ends of the ribs. We find the same in *Anosteira* and *Pseudotrionyx*. In all the Staurotypidæ and Cinosternidæ one or more of the posterior neurals are absent, and in all only one postneural is developed. In *Anosteira* and *Pseudotrionyx* there are only seven neurals and one postneural.

The form of the xiphiplastron in *Anosteira* is like that of the Cinosternidæ (especially *Monochelys*); but whether the endoplastron was present or not is still a question. The Staurotypidæ have this element; in the Cinosternidæ it is missing. Prof. Cope* observes that in *Staurotypus* the endoplastron (mesoplastron, Cope) is missing.

But after examination of Prof. Cope's originals I find that there is a well-developed endoplastron, as mentioned by Günther and Boulenger. Le Conte† has stated that a rudiment of the endoplastron is present in the young Cinosternidæ. I find in specimens of *Monochelys odorata* and *Cinosternum pennsylvanicum* (length of plastron 15 millim.), which I owe to the kindness of Prof. A. Agassiz, no trace of an endoplastron. The epiplastra are separated from the hyoplastra in the median line, the xiphiplastra from the hypoplastra, forming two considerable fontanelles.

Hyo- and hypoplastra are suturally united, without any fontanelle in the middle.

The plastron of the Cinosternidæ and probably the Staurotypidæ develops in a way totally different from the other Testudinata, so far as I am aware. We always find in them a median fontanelle in the young animal. Until it is ascertained whether *Anosteira* and *Pseudotrionyx* have an endoplastron or not, it is impossible to determine the correct systematic position. Undoubtedly these forms are very near to the families mentioned.

It is probable that the nuchal had well-developed lateral processes; I find a groove for such a process on the second peripheral, but none on the first. I have not seen, however, a complete nuchal. In *Pseudotrionyx* there is no trace of a protuberance on the eighth pleural (fig. of Dollo). This is present in the Cinosternidæ, where the ilium is connected; I do not know how the Staurotypidæ are in this regard, having no skeleton before me now. Until the endoplastron-question

* Cope, E. D., "Catalogue of Batrachians and Reptiles of Central America and Mexico," Bull. Un. Stat. Nat. Mus. no. 32, Washington, 1887, p. 23.

† Le Conte, John, "Description of four new Species of *Kinosternon*," Proc. Acad. Nat. Sci. Philad. vol. vii. 1854-55: Philadelphia, 1856, p. 186.

is solved, *Anosteira* and *Pseudotrionyx* may be placed (provisionally following Boulenger) in a separate family.

The question now arises, what is *Apholiclemys* of Pomel*? We are still restricted to the very short original description of 1847, nothing new having been published since this time. Pomel's words are:—"Mr. Lévêque a recueilli dans le calcaire grossier, à Cuise-la-Motte, près Compiègne, des tortues sans écailles, ou trionyx, qui ont un caractère remarquable dans la présence de pièces marginales bien plus développées que dans les cryptopus, avec un plastron, comme dans les gymnopus. C'est un liaison entre les émydes et les trionyx, bien plus évidente que par le trestosternum, puisque certaines émydes vivantes ont aussi ces granulations de la surface. Ici c'est un carapace à laquelle il ne manque plus que des écailles pour être celle d'une émyde à surface tuberculée; je donne à ce nouveau sous-genre le nom d'*Apholiclemys*, renfermant probablement deux espèces (*A. sublavivis* et *A. granosa*)."

Gervais† calls these forms "*Trionyx granosa*" and "*Trionyx lavigata*," without giving any reasons, and says that according to Mr. Graves they are found in "les sables glauconieux moyens de Cuise-la-Motte et de Pierrefonds." The "whereabouts" of the type specimens seem to be unknown. I am obliged to Prof. A. Gaudry for the following communication (April 23, 1888):—"On m'a dit que les échantillons de la collection Lévêque sur lesquels M. Pomel dit avoir fait son travail ont été dispersés."

It is possible that *Apholiclemys* may be identical with *Anosteira* or *Pseudotrionyx*, and it would be very interesting if the remains of this form could be figured and redescribed. That *Pseudotrionyx* is a different genus from *Anosteira* seems to be certain. In *Pseudotrionyx* a small "fontanelle" is present between the carapace and plastron ("échancrure naturelle, reste d'une fontanelle latérale," Dollo). Is it not possible that this place is filled up by a mesoplastron?

The Cinosternidae and Staurotypidae are found at present only in the northern parts of South America, in Central America, and North America; the discovery of such or allied forms in the Eocene of Europe is of great interest‡.

New Haven, Conn.,
Feb. 3, 1889.

* Pomel, "Note sur les Mammifères et les Reptiles Fossiles des Terrains éocènes de Paris inférieurs au dépôt Gypseux," Supplément à la Bibliothèque Univ. de Genève, Arch. des Sc. phys. et nat. tome iv. p. 328 (Genève, Paris, 1847).

† Gervais, Paul, 'Zoologie et Paléontologie française,' deuxième éd., Paris, 1859, p. 440.

‡ I do not know whether *Dithyrosternon*, Pictet, belongs here, not having seen the figures of this fossil.

XXX.—On new Species of Histeridæ.

By GEORGE LEWIS, F.L.S.

THIS paper is the fifth of a series published in this periodical relating to the Histeridæ. The first appeared in 1884, the second and third in 1885, and the fourth in 1888. The aggregate number of species treated of in the several memoirs is 181.

List of Species now noticed.

| | |
|---------------------------------|---------------------------------------|
| Phylloma exutum. | Hister circularis. |
| Platysoma palmipes. | — pyxidatus. |
| — Gorhami. | — tenuistriatus. |
| — baliolum. | Stictostix californicus, <i>Horn.</i> |
| — punctulatum, <i>Lewis.</i> | Carcinops currax, <i>Mars.</i> |
| — delicatum. | — ovatula. |
| — scitulum. | Triballus catenarius. |
| Eblisia convexa. | Sternocelis Sedilloti. |
| Epierus rufulus, <i>Lewis.</i> | Saprinus aterrimus, <i>Er.</i> |
| Pachycrærus modestus. | Teretrius basalis. |
| Cœlocræra nitida, <i>Lewis.</i> | Teretriosoma cyaneum. |
| Hister africanus. | — facetum, <i>Lewis.</i> |
| — sulcipygus. | Trypanæus bipustulatus, <i>F.</i> |

Phylloma exutum, n. sp.

Oblongo-ovatum, depressum, nigrum, nitidum : fronte antice transversim impressa, medio subtuberculata ; mandibulis latioribus ; pronoto utrinque obscure punctulato, linea ante scutellum, stria laterali integra ; elytris margine inflexo parum rugoso, striis 2 dorsalibus brevibus ; propygidio bifoveolato, circum punctato, in medio linea longitudinaliter elevata ; pygidio dense punctato, margine anguste lævi ; prosterno plano ; mesosterno late emarginato, haud striato ; tibiis anticis 5-dentatis.

Long. $9\frac{1}{2}$ millim.

This species is nearly as broad again as *P. mandibularis*, Mars. (with the type of which it has been compared), but its general similarity is greater to that than to any other known species. The frontal median elevation or tubercle is not conspicuous, otherwise it might be said to correspond with *P. monodon*, Mars., in this particular. The elevated median line on the pygidium is very distinct between the two foveæ, but it is evanescent at the centre. The pygidium is punctured in the middle, with a smooth margin somewhat like that of *P. facetum*, Lewis, figured in Biol. Centr.-Amer., Col. vol. ii. pt. 1, pl. iv. fig. 17 a, but narrower. *Phylloma* is a genus erected by Erichson in 1834 for *Hololepta corticalis*, Paykull,

which is a very different species from the others included in *Phylloma*; and whether the characters which are now held to separate them from *Lioderma* and *Hololepta* will permanently be regarded as satisfactory, it seems too early in the study of the group to decide. Paykull first published *Hololepta* in 1811, and the first species referred to the genus is now known as *Platysoma depressum*, F., and the second as *Paromalus complanatus*, Panz.; the type of *Hololepta* is now considered to be *plana*, Fuessly.

Hab. Ecuador.

Platysoma palmipes, n. sp.

Oblongo-ovatum, subdepressum, nigrum, nitidum; fronte impressa, stria transversa recta; pronoto stria integra; elytris striis 1^a-3^m integris parum late impressis, 5^a ante medium, 4^a valde abbreviatis, suturali obsoleta, epipleura valde bicarinata; propygidio utrinque impresso, punctato; pygidio apice marginato, dense ocellato-punctato; prosterno haud striato, subparallelo, vix convexo; mesosterno antice emarginato, stria integra; tibiis late dilatatis, anticis et posticis fortiter 4-dentatis.

Long. 6-6½ millim.

This fine species is apparently similar to *P. Hageni*, Mars., a species I know only by description. The first three striae of the elytra are wide, the epipleura bicarinate, the anterior angles of the thorax obtusely produced, and all the tibiæ are remarkably dilated, corresponding in this respect to *Hister latitibiis*, Mars. In *P. Hageni* the mesosternal stria is interrupted and the insect only measures 4 millim.

Hab. Lampongs, Sumatra (*Van de Poll*).

Platysoma Gorhami, n. sp.

Oblongo-ovatum, subdepressum, nigro-nitidum; fronte tenuissimo punctulata, leviter depressa, stria sinuata; pronoto angulis anticis valide productis, stria integra vix profunde impressa, ante scutellum minute foveolato; elytris striis 1^a-2^a integris validis, 3^a in medio parum interrupta, 4^a apicali; propygidio biimpresso, transversim punctato; pygidio grosse et dense punctato, posterius marginato; prosterno medio vix angusto, haud striato; mesosterno leviter sinuato, stria integra; tibiis anticis 4-, posticis 3-dentatis.

Long. 5½ millim.

This species is one third smaller than *P. Murrayi*, Mars., from Old Calabar, and the mesosternal stria leaves only a narrow margin in the first, but in *Murrayi* it is broad.

Hab. Zanzibar.

This is a capture made by Dr. Livingstone, and I am indebted to my friend the Rev. H. S. Gorham for the specimen.

Platysoma baliolum, n. sp.

Ovatum, subdepressum, nigrum, nitidum, punctulatum; fronte impressa, stria integra supra oculos valida; pronoto transverso, stria integra pone oculos crenata; elytris striis 1^a-4^m integris, 5^a basi, 6^a medio abbreviatis; propygidio transversim, pygidio undique, grosse punctatis; prosterno haud striato; mesosterno leviter emarginato, stria integra tenuiter impressa; tibiis anticis 4-dentatis. Long. 2½ millim.

This little species is about one third of the stature of *P. capense*, Wiedem., and resembles it in form and sculpture. In *baliolum* the punctuation of the elytra is much finer than that of the thorax, the fourth elytral stria is complete, and the fifth nearly so; the prosternum is narrow beyond the coxa, the basal lobe being almost circular in outline. In *capense* the prosternum is narrow and the basal lobe scarcely widened out at all, and the surfaces of the sterna are much more conspicuously punctulate.

Hab. Zanzibar (*Raffray*).

Platysoma punctulatum, Lewis, is a variety of *P. capense*, Wiedem., and the locality given for it—Assam—is probably an error.

Platysoma delicatum, n. sp.

Oblongo-ovatum, parum convexum, rufo-piceum, nitidum; fronte vix concava, punctata, supra oculos elevata; pronoto in medio levissime longitudinaliter impresso, sparse et minime profunde punctato, stria pone oculos interrupta, parte in medio utrinque hamata; elytris apicibus punctulatis, striis dorsalibus 1^a-6^m integris; propygidio pygidioque sparse punctulatis; prosterno lobo grosse punctato, bistriato, striis utrinque junctis; mesosterno late emarginato marginatoque; tibiis anticis 7-8-dentatis, posticis 3-4-spinosis. Long. 2 millim.

This species is unlike any other I know, but it may be a type of *Platysoma* peculiar to South America, in which country, however, the genus is very poorly represented. In the form of the thoracic stria it corresponds with some of the cylindrical species, such as *P. Aubei*, Mars. (Mon. 1861, p. 152, t. iii. fig. 12). The thoracic punctures are shallow, somewhat oblong, and finely cut, and the elytral striæ are all complete.

Hab. Tambillo, Brazil (*Reitter*).

Platysoma scitulum, n. sp.

Ovato-parallelum, subdepressum, nigro-piceum, nitidum; fronte concava, vix dense punctulata, stria transversa tenuiter impressa in medio sinuata; pronoto subquadrato, lateribus late punctato, stria pone oculos interrupta (ut in *P. delicato*); elytris striis 1^a-3^m integris, 4^a-6^m brevibus; propygidio grosse et prave punctato; pygidio utrinque impresso, undique punctato; prosterno plano, parum lato, haud striato; mesosterno valide marginato, late emarginato, lateraliter bistriato, metasterno medio leviter impresso; tibiis anticis 3-dentatis.

Long. 4 millim.

Platysoma scitulum is remarkable in having the thoracic stria interrupted behind the eyes, with the median portion hamate at either end. The three abbreviated striæ of the elytra are feebly impressed and are placed before the apex, the middle one being the shortest and most faint and the sutural one in front of the others. The propygidium is irregularly punctured, the punctures inclining to ocellation, and some are deeper anteriorly than behind. The species may be inserted in the catalogue near *P. paugami*, Mars.

Hab. Borneo (*Wallace*).

EBLISIA, nov. gen.

This genus is proposed to receive *Phelister lunaticus*, Mars., and its allies *celebius*, *speculipygus*, and *convexa*—species which have no frontal depression such as would authorize their inclusion in *Platysoma*, and yet at the same time the mesosternum is emarginate in front, a salient character which must exclude them from *Phelister*. The type of *Phelister* is *venustus*, Mars., an insect which has the mesosternum produced in front, and the generic character "mesosternum bisinuatum" is conspicuous. But in *lunaticus* the prosternum corresponds with that in *Platysoma*, inasmuch as one of the essential characters of the genus is "prosternum compressum, basi rotundatum in mesosterno receptum." The genus *Platysoma* at present contains some species which I think must ultimately be detached from it; I speak of species such as *decemstriatum*, Motsch., and *exiguum*, Lewis; but I think these may be assigned at present to the genus *Nicotikis*, Mars., suggested for *Platysoma incisipygus* (Bull. Soc. Ent. Fr. (6) iii. p. 67).

Eblisia convexa, n. sp.

Ovata, convexuscula, nigra, nitida; fronte impunctata, convexa, stria

transversa valida ; pronoto stria integra lateraliter valida, post oculos leviter impressa, margine lato ; elytris striis 1^a integra, 2^a basi abbreviata, 3^a postice late interrupta, 4^a-5^a apicalibus, suturali nulla ; propygidio utrinque late impresso, medio longitudinaliter anguste elevato ; pygidio convexo, impunctato, basi utrinque profunde excavato ; prosterno basi subimpresso, haud striato, parce et tenuissime punctulato ; mesosterno stria marginali arcuatim integra ; tibiis anticis 4-5-dentatis.

Long. 4 millim.

This species has something of the facies and is of the size of *Hister ruficornis*, Grimm, and is therefore longer and more convex than its near allies *Phelister lunaticus* and *celebius*, Mars. The fossettes in the pygidium are very large and round, after the manner of those in *Apobletes diopsipygus*, Mars., and the space between them and the apex of the segment is smooth.

Hab. Borneo (*Doherty*).

Note.—I have placed a remarkable Histerid in *Epierus*, viz. *Epierus rufulus*, Lewis (Biol. Centr.-Amer., Coleopt. vol. ii. pt. 1, p. 208), because, although it has the facies of a *Phelister*, except perhaps in the forehead, the mesosternum is emarginate anteriorly, and Marseul's definition of *Phelister* is that the mesosternum is "bisiné en devant, avec une petite pointe médiane qui répond à l'échancre de la base du prosternum." In *Phelister*, *Pachycrærus*, *Trypanæus*, and allies the projecting mesosternum is a valid and salient character, and I think it cannot be desirable to associate species together which differ so essentially in this respect as *Epierus rufulus*, Lewis, and *Phelister venustus*, Mars.

Pachycrærus modestus, n. sp.

Oblongo-ovatus, subconvexus, nigro-piceus : antennis pedibusque rufis ; fronte impressa, stria valida integra ; pronoto sat fortiter punctato, stria post oculos late interrupta ; elytris apicibus punctatis, striis 1^a-3^æ dorsalibus integris, 4^a interrupta, 5^a et suturali abbreviatis ; propygidio pygidioque punctatis ; prosterno bistriato, striis parallelis ; mesosterno marginato, stria integra ; tibiis anticis 7-, posticis 3-dentatis.

Long. 3 $\frac{1}{4}$ millim.

This species is similar to *P. arabicus*, Lewis, in colour, and to *P. Bocandei*, Mars., in size and form. The prosternal stræ widen out at the base, but are almost parallel beyond the coxæ, and terminate at the transverse stria which divides the main part of the sternum from the lobe.

Hab. Zanzibar (*Raffray*).

Pachycærus arabicus, Lewis, is less convex and more oval than *modestus*, with the three abbreviated elytral striæ more lightly impressed and shortened also posteriorly. The forehead is more convex within the area of the stria, the pronotum is more transverse and less punctured in the centre, and the prosternal striæ are wider apart, not quite so parallel, and the interstice between them is more truncate in front.

Cœlocæra nitida, Lewis.

This species should be placed in *Phelister* until the genus is more fully revised; the insect is allied to *P. circulifrons*, Mars., from Senegal. It differs especially from the latter by the fourth elytral stria being complete and the fifth reaching the middle. The sutural stria is similar in both insects.

Hister africanus, n. sp.

Ovatus, parum convexus, niger, nitidus; fronte plana, stria integra antice subcreta; pronoto striis duabus pone oculos coalescentibus; elytris striis 1^a–5^m integris, 6^a basi abbreviata, 7^a magis longa; propygidio pygidioque dense et parum grosse punctatis; mesosterno subemarginato, stria marginali integra; tibiis anticis 3-dentatis. Long. 7 $\frac{1}{4}$ millim.

The figure of *Hister afer*, Paykull, given in his monograph, tab. xiii. f. vi., agrees well with this species, except that in *africanus* the thorax is impunctate, the propygidium and pygidium are densely punctate, and the fifth dorsal stria is longer and the sixth shorter. Paykull's species came from Guinea, mine is labelled by Mr. Bates (to whom I am much indebted for a unique example) "River Lujenda, East Africa." Both the species mentioned above have the elytral striæ arranged on a similar plan to *Contipus didymostrius*, Mars., and *Hister mtesa*, Ancy, but the last has the mesosternum very curiously sculptured. The punctuation of the pygidium and the form of the mesosternum in *H. africanus* and *Mechowi*, Schmidt, are almost identical.

Hab. E. Africa.

Hister sulcipygus, n. sp.

Ovalis, convexus, niger, nitidus, lævis; fronte antice biimpressa, stria elevata antice recta; mandibulis bidentatis, extus marginatis; pronoto striis 2 lateralibus validis ante basin terminatis; elytris striis 1^a–3^m integris, 4^a apicali brevi vel obsoleta; propygidio pygidioque sat dense et grosse punctatis; pygidio utrinque profunde sulcato; prosterno haud striato; mesosterno antice parum lato,

recto, stria integra; tibiis anticis valide tridentatis, posticis biserialim spinosis.

Long. $7\frac{1}{4}$ millim.

Hister sulcipygus should be placed in the list next to *ignavus*, Fähr., as it agrees with it in several characters, such as the subhumeral stria, general contour, and punctuation. The differences are that the epistoma is round and marginate anteriorly, mandibles marginate, frontal stria elevated, and the thoracic striæ are but two in number. The propygidium is wholly punctured, and the two sulci on the outer margin of the pygidium are deep, somewhat oval, and unlike anything yet seen in the genus *Hister*.

Hab. Mombas.

I am much indebted to Mr. H. W. Bates for a specimen of this singular insect.

Hister circularis, n. sp.

Breviter ovalis, depressus, niger, nitidus; fronte triangulariter excavata, stria transversa elevata, utrinque angulata, mandibulis extus marginatis; pronoto stria externa dimidiata, interna integra, antice crenulata; elytris striis 1^a-3^m integris validis, 4^a et 5^a apicalibus brevissimis, tenuiter impressis, suturali basi abbreviata; propygidio utrinque leviter impresso, parce punctulato; prosterno parum brevi; mesosterno haud sinuato, stria integra tenuiter impressa; tibiis anticis valide 3-dentatis.

Long. $6\frac{1}{2}$ millim.

Macrosternus circularis, Mars., has a similar outline and convexity to this species, and I have adopted the same trivial name for it. At present the species, although it is very dissimilar to any hitherto described except *H. circulus*, Schmidt, the description of which is in the press, may be placed in the same group as *aquatorius*, Mars. The prosternum is divided into two nearly equal parts by a transverse line; the anterior lobe is punctured and has three well-marked striæ on each side. The anterior outline of the mesosternum is feebly bow-shaped.

Hab. Senegal.

There is one specimen in the British Museum, another in my own cabinet.

Hister pyxidatus, n. sp.

Ovalis, parum convexus, niger, nitidus; fronte stria valida antice recta; pronoto tenuissime punctulato, stria laterali interna integra, externa brevi; elytris striis 1^a-3^m integris, 4^a et 5^a brevissimis, suturali dimidiata; propygidio utrinque impresso parum dense pygidio

subtiliter punctatis ; prosterno ut in *helluone* ; mesosterno sinuato, stria integra ; tibiis anticis 3-dentatis, posticis multispinosis. Long. 6 millim.

This species is extremely like *H. helluo*, Mars. The differences are : the head is broader, the lateral punctures of the thorax are absent, the fourth elytral stria is apical and very short, and the sutural much abbreviated at the base, but very clear, and it is curved outwards towards the apex. Beneath, the mesosternum is feebly emarginate and the stria is nearly straight anteriorly. In *H. helluo* the stria follows the course of the anterior emargination. The anterior tibiæ also are tridentate. I have seen the type of *Hister helluonides*, Mars., and it differs from *helluo* much more than the present species.

Hab. Abyssinia (*Raffray*).

Hister tenuistriatus, n. sp.

Ovalis, parum convexus, niger, nitidus ; fronte longitudinaliter impressa stria valida ; pronoto antico utrinque sinuato, stria interna valida integra, externa tenuissime impressa, basi vix abbreviata ; elytris striis 1^a-3^m validis integris, 4^a dimidiata vix interrupta, 5^a apicali brevissima, suturali basi late abbreviata ; propygidio parce punctato, pygidio probe levi ; prosterno vix brevi transversim sulcato, lobo antico impunctato ; mesosterno haud emarginato, stria integra, sed tenuiter impressa.

Long. 6½ millim.

The shape of the thorax behind the head gives an outline which corresponds with the outline given in the figure of *Terapus*, Mars, Mon. 1862, t. 7, no. 45, f. 1. The outer thoracic stria is very fine, close to the marginal edge, and it terminates just before the base, and between it and the inner stria there is a broad interstice. To be placed in the catalogue near *Hister singalanus*, Mars.

Hab. Borneo (*Doherty*). Two examples.

STICTOSTIX, Marseul, Ann. Soc. Belg. xiii. 1870, p. 92.

Triballus californicus, Horn, may be placed in this genus provisionally, for although its outline is very different from that of *S. parra*, Mars., its general characters seem to be the same.

Carcinops currax, Marseul, 1870 = *C. geminata*, Leconte, 1859. Specimens are extant in collections which have been labelled "Oran, Algeria," and this has no doubt misled Marseul. This species, with *C. radula*, Mars., *Garbigliettii*, Mars., *conjuncta*, Say, *multistriatus*, Lewis, and *punctinotus*, Lewis, belong to the genus *Xestipyge*, Mars. Mon. 1862, p. 6.

Carcinops radula, as suggested in the Biol. Centr.-Amer., Col. vol. ii. pt. 1, p. 209, is probably a native of California, whence I have lately received a specimen sent with a series of *C. consors*.

Carcinops ovatula, n. sp.

Late ovalis, parum convexa, nigra, subnitida; fronte sparse punctulata, stria supra oculos subelevata, antice late interrupta; pronoto stria marginali integra, sparse punctato; elytris striis humerali et 5 primis integris, suturali antice parum abbreviata; pygidio rufo, subtilissime punctulato, basi utrinque foveolato; prosterno vix lato, bistriato, striis basi conjunctis; mesosterno antice recto et marginato; antennis pedibusque rufis.

Long. $2\frac{3}{4}$ millim.

This species closely resembles *C. consors*, Leconte, but it is much broader, and the mesosternum is not sinuate in front. The two foveæ in the pygidium are distinctive characters in *ovatula*, and will serve to separate it from *consors* and *gilensis*, Leconte.

Hab. Blumenau, S. Brazil.

(There is a reference to this species in the Biol. Centr.-Amer., Col. vol. ii. pt. 1, 1888, p. 210.)

Triballus catenarius, n. sp.

Breviter ovalis, convexus, brunneus, nitidus; antennis pedibusque ferrugineis; supra tenuiter et minutissime punctulatus; fronte impressa stria supra oculos valida, antice interrupta; pronoto stria laterali integra, basi transversim punctata, ante scutellum subfoveolato; elytris stria humerali integra, dorsali nulla; prosterno bistriato et undique minutissime tessellato; mesosterno stria antice late interrupto, postice recto perspicue impresso.

This species is the size of *T. Kœnigius*, Mars., but it is more oval, brown in colour, the dorsal punctures are barely visible, and the prosternum is not punctured, but very finely and closely tessellate, and the stria which indicates the base of the mesosternum is not crenulate but very clearly catenulate, agreeing in this respect with *T. Ogieri*, Mars., and *colombius*, Mars.; but in *colombius* the stria is feebly arcuate.

Hab. Pulo batu (*Semper*).

Sternocælis Sedilloti, n. sp.

Breviter ovalis, supra parce pilis fulvis erectis, brunneus, nitidus; pedibus dilutioribus; fronte dense punctata, stria utrinque valida; pronoto angulis obliquis, antice vix dense ocellato-punctato, postice parce punctulato; elytris disperse punctulatis, tristriatis,

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stria 3^a dimidiata; propygidio vix dense ocellato-punctato; pygidio obscure punctato; prosterno probe lato, inter striis plano, undique grosse et minime profunde punctato, stria laterali ante coxas parum divaricata; tibiis valide triangulariter dilatatis.

Long. $1\frac{3}{4}$ millim.

In colour this species agrees with *politus*, Schmidt, and it is pilous in the same way, but the prosternum is on a different plan. In *Sedilloti* the prosternum between the striae is on one plane, the surface is sculptured with large shallow punctures closely set together and more or less rugose anteriorly, the rugosity being most apparent on the lobe; and the base, as in *pluristriatus*, Fairm., is narrowly smooth. The prosternal striae are one third wider apart than in *pluristriatus*, and they diverge slightly in front of the coxæ.

In many species of this genus the prosternum has a transverse bulge or ridge across the centre of the keel; it may be observed well in *S. cancer*, *Bedeli*, *punctulatus*, and *pluristriatus*. But in the *hispanicus* and *arachnoides* group there is a transverse sulcus which divides the main part of the prosternum from the lobe. In these last species the lobe is said to be reflexed. Monsieur Sédillot, whose labours in connexion with the Mediterranean fauna are well known, captured this species at Kef Kourrat, in the Province of Constantine, in 1886.

Saprinus aterrimus, Erichson.

A long series of this insect, recently brought from S. Catherine, shows that the species possesses somewhat similar sexual characters to those in *Saprinus ancicollis*, Mars., and *cæso-pygus*, Mars. The female has a very deep sulcus in the apex of the pygidium, formed like a widened-out V, and the intermediate angle is prominent.

Teretrius basalis, n. sp.

Cylindricus, subelongatus, subrufus, nitidus, undique punctulatus et minutissime strigosus; fronte parum convexa, haud striata; pronoto stria integra; elytris transversim basi rufo-marginatis; prosterno basi impresso striis obscuris divaricatis, lobo antice marginato; mesosterno marginato, parum acute producto; tibiis anticis 7-dentatis.

Long. $2\frac{1}{4}$ millim.

This species is about the size of *picipes*, F., but rather more cylindrical. The elytra are without the smooth bases so commonly seen in the genus, but immediately behind such

corresponding areas is a narrow reddish band. The prosternum is margined in front, and has a lateral sinuate stria which passes from the anterior margin, from a point nearly behind the eyes, to the coxæ. The ordinary striæ between the coxæ are very faint and gradually diverge from their bases.

Hab. Australia.

I am much indebted to Mons. Antoine Grouvelle for a unique example he has received from Adelaide.

Teretriosoma cyaneum, n. sp.

Subcylindricum, cyaneum, nitidum; antennis pedibusque rufis; supra subocellato-punctatum; fronte plana haud striata; pronoto stria integra, margine laterali vix elevato; propygidio pygidioque æqualiter punctatis; prosterno mesosternoque latis et immarginatis; tibiis anticis intus parve flavo-ciliatis, extus 6-7-, intermediis 7-spinosis.

Long. $3\frac{1}{4}$ millim.

This species is less brilliant than *T. festivum*, Lewis; it may be distinguished by the scape of the antennæ having long flavous hairs which are very conspicuous. The prosternum has a small impression at its base, and the mesosternum is very obtusely produced in front.

Hab. Brazil (*Dr. Sahlberg*), no. 2788.

Teretriosoma facetum, Lewis.

This species has the prosternum covered with large punctures, and it is not striated. The mesosternum has similar punctures, but they are not set so closely together, and the anterior margin is bordered by a stria. The concave portion of the pygidium is rugose.

Trypanæus bipustulatus, F.

"Cylindricus, ater, nitidus, thorace elytris longiore; elytris punctis rufis. Affinis præcedenti [*proboscideus*], at minor et elytra macula magna rufa.

"*Hab.* in America mer."

This memorandum refers to a species about the size of *miles*, Mars.; but as the description is of no value, it will be best to consider the name a manuscript one.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

November 21, 1888.—W. T. Blanford, LL.D., F.R.S.,
President, in the Chair.

The following communications were read:—

1. "Notes on the Remains and Affinities of five Genera of Mesozoic Reptiles." By R. Lydekker, Esq., B.A., F.G.S.

This paper was divided into five sections. In the first the Author described the dorsal vertebra of a small Dinosaur from the Cambridge Greensand, which he regarded as probably identical with the genus *Syngonosaurus*, Seeley. Reasons were then given for regarding this form as being a member of the Seelidosauridae, stress being laid on the absence of a costal facet on the centrum.

The second section described an axis vertebra from the Wealden of the Isle of Wight, which is evidently Dinosaurian, and may possibly belong to *Megalosaurus*. It is remarkable for exhibiting an intercentrum on its anterior aspect, and also for the absence of anchylosis between its centrum and that of the atlas.

In the third section the femur of a small Iguanodont from the Oxford Clay, in the possession of A. R. Leeds, Esq., was described. This specimen agrees with *Hypsilophodon* and *Camptosaurus* in its pendent inner trochanter, and it was referred to the latter genus as *C. Leedsi*. It is also considered to be closely allied to *Iguanodon Prestwichi*—the type of *Cumnoria* of Seeley—which is also considered to belong to the American genus. The name *Camptosaurus valdensis* was applied to an allied form from the Wealden; and the name *Cryptodraco* proposed to replace *Cryptosaurus*.

The imperfect skeleton of a Sauropterygian from the Oxford Clay near Bedford, which formed the subject of a previous communication, was redescribed. This specimen was identified with *Plesiosaurus philarchus*, Seeley, which it was proposed to refer to a new genus under the name of *Ploneustus*. This genus was shown to be allied to *Pliosaurus*, and to be represented by forms in the Kimmeridge Clay which have been described as *Plesiosaurus aqualis* and *P. stenodirus*. It was also compared with the genus *Thaumatosauros*, Meyer, from which *Rhomalosaurus* of Seeley was considered inseparable. Some remarks were added on other Sauropterygians; and it was proposed to adopt the name *Cimoliosaurus* for all the forms having a pectoral girdle of the type described under the names of *Elamosaurus* and *Colymbosaurus*, and with single costal facets to the cervical vertebrae.

The paper concluded with a notice of the affinities of the Crocodilian genus *Geosaurus*. This form was shown to be closely allied to *Metriorhynchus*, both being characterized by the absence of dermal scutes and the presence of bony plates in the sclerotic. It was also shown that some of the species of *Uricosaurus* belong to the former genus; while there appear to be no grounds by which *Dacosaurus* (*Plesiosuchus*) can be separated from the same.

2. "Notes on the Radiolaria of the London Clay." By W. H. Shrubsole, Esq., F.G.S.

Microscopical examination of the London Clay of Sheppey and elsewhere has afforded proof of the existence of a Diatomaceous zone near the base of the formation. The formation of a well for the Queenborough Cement Company in 1885 was the means of furnishing a laminated clay with glittering patches of Diatoms from a depth of 225 feet. In this were also found fairly good pyritized specimens of Radiolaria, some of which were submitted to Prof. Ernst Hæckel, who found a large number of fragments of Tertiary Radiolaria, but few well-preserved specimens appertaining to the families Sphæroidea, Discoidea, and Cyrtocidea, and apparently identical with those described from the Tertiary Tripoli beds of Grotte. No new species occurred among the recognized forms.

Sketches made by Mr. A. L. Hammond were also submitted to Prof. Hæckel, who stated that these forms were not identical with any known species, recent or fossil.

The Author described the following new species:—*Cornutella Hammondi*, *Spongodiscus asper*, and *Monosphaera toliapica*.

The specimens were preserved in iron-pyrites.

Some Tetractinellid sponge-spicules from the washings were recognized by Professor Sollas.

3. "Description of a new Species of *Clupea* (*C. vectensis*) from Oligocene Strata in the Isle of Wight." By E. T. Newton, Esq., F.G.S.

A number of small fishes found by Mr. G. W. Colenutt, of Ryde, during his investigations of the Oligocene strata of the Isle of Wight, in beds belonging to the "Osborne Series," were described as belonging to a new species of *Clupea*. The specimens vary in length from 20 to nearly 60 millim. In all of them the head is much broken; but the rest of the body is beautifully preserved, showing most distinctly the vertebral column, ribs, fins, tail, and ventral spines. The single dorsal fin has its front rays about midway between the tip of the snout and the base of the tail, the ventral fins being immediately under the front of the dorsal and about midway between the pectoral and anal fins. The anal fin commences about halfway between the ventral fins and the base of the tail, occupying about two thirds of that distance, and the tail is deeply forked. The scales are thin and in most cases much broken; while the ventral region of the body is armed with a row of strong spines. The spinal column contains about 40 vertebræ, of which 14 or 15 are caudal. The bones of the head are mostly broken, but those of which the outline can be traced agree with the corresponding parts of the Sprat.

These fishes are referred to the genus *Clupea*; but although very closely allied to the Common Herring and Sprat, the relative positions of the dorsal and ventral fins, as well as the number of vertebræ, prevent their being placed in any known species either recent or fossil, and they are therefore regarded as a new form and named *Clupea vectensis*.

MISCELLANEOUS.

Note on the Relative Claims to Recognition of the Generic Names
Arbacia, Gray, and Echinocidaris, Des Moulins. By F. JEFFREY
 BELL.

IN the year 1835 Dr. J. E. Gray and M. Des Moulins gave respectively the names *Arbacia* and *Echinocidaris* to the same type of Echinoids. The latter claimed priority *, "puisque mon Tableau synoptique des genres . . . a été publié en août 1835," while, he says, the name of Gray was not published till October 1835. Mr. A. Agassiz, in his 'Revision of the Echini' (p. 90), gave the priority to Gray, adding to his name "April," to Des Moulins's "July:" these months mark, however, only the date of reading; the date of publication, which is quite another matter, was for Des Moulins's name August 15; that of Gray's name cannot be definitely asserted from the contents of the 'Proceedings of the Zoological Society' for 1835, and the only known date was the republication in the October number of the 'Philosophical Magazine.' I have now to say that at my request Mr. Williams, of the Zoological Society, has instituted a search through their records, and finds that the sheet containing Gray's paper "was delivered to the Society at their rooms on the 17th July, 1835. In those days sheets so soon as printed off were distributed to the Fellows." I am afraid, therefore, the case for Gray's nonsense name as against Des Moulins's happy suggestion is complete and that we cannot avoid using the name *Arbacia*.

On the presence of Spinnerets in the Myriopoda.
 By M. JULES CHALAUDE.

One of the principal characters of the Araneida consists in the presence at the extremity of the abdomen of spinnerets, or tubes, serving for the outflow of the secretion of spinning-glands. The existence of analogous organs has not hitherto been demonstrated in the Myriopoda, although M. Fabre, of Avignon, having remarked that the spermatophores of the *Geophilæ* are deposited upon nets composed of threads like those of spiders, concluded that the Chilopoda must spin these themselves with the secretion of their genital glands†. My observations upon those animals have not yet furnished me with exact facts demonstrative of the opinion expressed by the above acute observer.

I have been more fortunate with another species, *Scolopendrella immaculata*, Newport. This Myriopod, which has been separated from the order Chilopoda to form that of the Symphyla (Latzel), presents the remarkable peculiarity of possessing an apparatus

* 'Etudes sur les Echinides,' p. 304.

† Ann. Sci. Nat. sér. 4, tom. iii. p. 305.

composed of two distinct glands, opening outwards in the two appendages placed on the margin of the anus.

These glands, which are situated on the two sides of the body of the animal, have the form of an elongated tube terminating caecally about the fifth anal segment. They present an anterior and a posterior portion. The former constitutes the gland properly so called, the latter its excretory canal. The glandular part occupies about two thirds of the total length of the organ ; its outer surface is rugged, and covered with an irregular network of intercrossing muscular fibres. The gland itself is occupied by a single large cavity filled with the secreted substance ; its wall is formed by a pavement-epithelium consisting of small cells charged with fine granulations, which is bounded externally by a thick and very resistant basement-membrane. The excretory canal is clearly indicated, externally by the disappearance of the muscular network, and internally by that of the lining cells, and at the same time by the considerable diminution of the thickness of the walls. It opens, as already stated, in the anal appendage of the same side.

These terminal appendages, as is well known, are formed by a single lanceolate joint, bristling with hairs, and terminated by a long and strong spine. M. Fabre*, who regarded these singular Myriopoda as young specimens of *Cryptops*, took these two appendages for the rudiments of the anal limbs.

Each appendage is traversed by a cavity, the diameter of which is greater than that of the excretory canal ; at its extremity, at the very base of the terminal spine, there is an aperture destined to afford a passage to the product of secretion. The liquid secreted by the gland is remarkable for its great viscosity ; it does not mix either with water or glycerine. On coming in contact with the air it hardens rapidly.

It is easy to ascertain that the product of secretion is conveyed out by the orifices of the terminal appendages ; in fact, on making the animal fall, we note that it remains suspended from the object from which it has been precipitated by an extremely delicate thread. This thread issues from the body of the animal by the aperture of the appendages above described, appendages which, consequently, constitute true spinnerets. These threads would be perfectly comparable with those of Araneida if they possessed the same elasticity ; but they are plainly distinguished from them by their fragility, which cannot be better compared than to that of a thread of glass.

It appears from my observations : (1) That *Scolopendrella im-maculata* possesses a glandular apparatus destined to secrete a liquid capable of hardening in the air and of forming threads very like those spun by the Spiders ; (2) that the anal appendages constitute true spinnerets.—*Comptes Rendus*, January 14, 1889, p. 106.

* *Loc cit.* p. 311, fig. 25.

Note on Antedon pumila and A. incommoda.

By F. JEFFREY BELL.

On p. 157 of the 'Alert' Report* I stated that the second pinnule of *Antedon pumila* was longer than the first: as a matter of fact it is the first that is longer than the second. This error has proved to be more than usually unfortunate, for it led Dr. H. Carpenter† to assign it to a group of species with which it has no special relation, and to my institution‡ of a new species, *A. incommoda*, for examples of what are really *A. pumila*. I regret, moreover, to learn that it has caused some trouble to the ardent naturalists who are now working so actively in Australia.

The Fauna of the Eifel-Maare. By Dr. OTTO ZACHARIAS.

At the suggestion of Prof. F. Leydig the author made an excursion into the region of the Eifel in order to examine some of the so-called "maare."

In the Gemündener Maar, near Daun, he ascertained the presence of a pelagic fauna, although the lake is but small, measuring only 8·3 hectares. The pelagic fauna consisted of swarms of a cinnabared *Diaptomus* (*D. pygmaeus*, Vosseler, sp. n.), of innumerable specimens of *Asplanchna helvetica*, of colonies of *Conochilus volvox*, and isolated examples of *Daphnella brachypura*, Liév. In the littoral zone there are other species of Daphniidae, some Lynceidae, and various species of Protozoa. Among them several species of Hydrachnidae, especially *Hygrobatas longipalpis*, Herm., occur in abundance.

The Laacher See, which is only a large "maar," also contains a pelagic fauna, which, however, includes other species than those of the small Gemündener Maar. Here *Daphnia vitrea*, Kurz, occurred, among numerous examples of *Polyarthra platyptera*, Ehr., *Anurea longispina*, *Conochilus volvox*, and the Dinoflagellate *Ceratium hirundinella*, Bergh.

The author remarks upon the fact that in such confined crater-lakes as the "maars" of the Eifel a pelagic fauna has been established. He regards this as an evidence of transportation by flying organisms, although in many cases the wind may come into operation, by carrying encysted Protozoa, for example, high into the air, and thus transplanting them into distant waters. Water-beetles also he regards as important agents in the transfer.—*Biol. Centralblatt*, November 15, 1888, p. 574.

* London, 1884.

† 'Challenger' Reports, part lx. p. 193.

‡ Ann. & Mag. N. H. (6) ii. p. 404.

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XXXI.—*Natural-History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander Alfred Carpenter, R.N., D.S.O., commanding.*—No. 9. *On a new Type of Astorhizidæ from the Bay of Bengal.* By HENRY B. BRADY, LL.D., F.R.S.

A FEW days ago, whilst on a short visit to this city (Calcutta), my good friend Mr. J. Wood-Mason, the Director of the Indian Museum, brought under my notice a number of Rhizopods of a type hitherto undescribed which he had recently dredged up (on board the 'Investigator') in the Bay of Bengal; and he has asked me to furnish a brief preliminary account of them for communication to the Microscopical Society of Calcutta* and for subsequent insertion in the 'Annals.'

The organisms referred to were obtained from two different localities, and present the characters of two distinct though closely allied species. The test in both forms consists of a thin arenaceous disk, but in the one case the disk is complanate, in the other more or less patelloid or tent-like; the

* Before which it was read on Feb. 14th, 1889: communicated by the President of the Society.

diameters, roughly speaking, about a quarter of an inch and half an inch respectively. The texture is loosely arenaceous, and the specimens are in consequence exceedingly fragile.

The general structural features can almost be read by the naked eye and are easily made out under a low magnifying-power. The test consists typically of a central chamber with a number of radiating tubes, either simple or branched, proceeding from it and extending to the periphery, the sandy investment forming a thin flat layer in the interstitial spaces. Mounted in Canada balsam and viewed by transmitted light the tubuli are seen to differ considerably in diameter in the two species, the larger form having the smaller tubuli. The central cavity is probably labyrinthic, for it often presents an irregularly reticulated appearance, as though more or less subdivided by aggregated sand-grains; but the inner surface of the tubuli is always smooth and appears to have a uniform chitinous lining. Externally the central chamber is usually marked by a small convex elevation and the tubes by limbate lines, generally more conspicuous on one side of the test than on the other.

Morphologically the new forms may be regarded as branched or radiate *Astrorhizæ* with the sandy investment continued between the arms, so as to produce an even, rounded, peripheral outline. Several specimens of the smaller species have no central chamber, and consist only of a branched tube traversing a thin lamina of agglutinated sand. This condition may be the result of fracture and subsequent growth, or such specimens may correspond to the "stag's-horn" variety of *Astrorhiza arenaria* ('Challenger' Foraminifera, pl. xix. figs. 7, 8).

Unfortunately only a few specimens were preserved out of the large number originally obtained, and owing to their extreme fragility still fewer are now left for examination. It is always difficult, even with sufficient material, to investigate the nature of the protoplasm of an arenaceous organism of this sort, and at present nothing can be said as to the presence or absence of a nucleus. The central chamber and tubuli appear to be nearly filled with slightly coloured protoplasmic matter.

As already observed, both species were abundant in the localities at which they were found, and there is little doubt they will soon be met with again; meanwhile the following descriptions will serve for their identification. Appended also are particulars as to their respective habitats. For obvious reasons I propose to associate Mr. Wood-Mason's name with the genus.

Family *Astrorhizidæ*.

Subfamily *ASTORRHIZINÆ*.

MASONELLA, nov. gen.

Test free, thin, outspread, discoidal or patelloid; consisting typically of a central chamber with radiating tubes, simple or branched, open at the periphery; the interstitial spaces occupied by plates of agglutinated sand-grains; texture arenaceous, with but little inorganic cement.

Fig. 1.

Fig. 2.

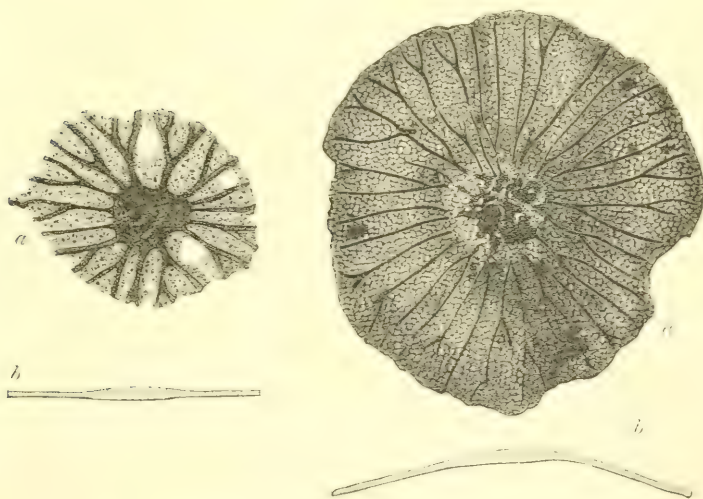


Fig. 1.—*Masonella planulata*, n. sp. Fig. 2.—*Masonella patelliformis*, n. sp. Magnified 5 diameters.

Masonella planulata, n. sp. (Fig. 1.)

Test thin, complanate, rounded or oval in outline; presenting (typically) a small central convexity about one third the diameter of the disk, nearly equally developed on the two lateral faces. Radial tubes numerous, from 0.1 to 0.2 millim. in diameter; either simple or dividing into two or three branches; limbate externally; the open peripheral extremities serving as the general aperture. Texture loosely

arenaceous; built up of light-coloured siliceous sand and sponge-spicules, the latter often in large proportion, together with a few Foraminifera and other minute organisms. Diameter of the figured specimen about 6 millim.; but fragments of much larger examples have been met with.

"Dredged 12th to 13th April, 1888; depth 250 fathoms; North Sentinel Island, Andamans, bearing N. 15° W. 18 miles; bottom green mud and sand. Multitudes of specimens came up on the tangle-bar, with a capital haul of *Umbrellula*, siliceous sponges, and Crustacea of deep-water types."

Masonella patelliformis, n. sp. (Fig. 2.)

Test free, thin; patelloid or subconical; central chamber about one fourth the entire diameter of the test, but irregular in form and outline; radial tubes from 0.05 to 0.1 millim. in diameter. Colour dark; texture loosely arenaceous, exterior rough; the central chamber and tubuli more strongly marked externally on the convex than on the concave face. Diameter of the figured specimen 10 millim., but fragments indicate that this is by no means the maximum size.

"Dredged 11th April, 1888; depth 265 fathoms; about 7 miles S.E. by E. of Ross Island, Andamans; bottom green mud. The specimens came up in great numbers on the swabs which were attached to the trawl."

Masonella patelliformis has a larger, coarser, and darker-coloured test than *M. planulata*, and its radial tubes are much thinner; its contour also is subconical, whilst that of the latter species is complanate.

The accompanying drawings (woodcuts, figs. 1, 2), made by a native artist, give a tolerably accurate idea of the two organisms. Fig. 1 *a*, represents the lateral aspect of *M. planulata*, 1 *b*, a diagram of its transverse section; fig. 2 *a*, *M. patelliformis*, 2 *b*, diagram of transverse section; all magnified 5 diameters.

Calcutta,
4th January, 1889.

XXXII.—*Palaeichthyological Notes*. By A. SMITH WOODWARD, F.G.S., F.Z.S., of the British Museum (Natural History).

[Plate XIV.]

1. *On the so-called Hybodus keuperinus, Murch. & Strickl.*

Detached Selachian teeth of a Hybodont or Cestraciont type have long been known from the Keuper of the Midlands, and one was figured so early as 1840 by Murchison and Strickland, who recorded it under the generic name of *Hybodus* *. Several of these teeth have now been discovered in natural association in the Upper Keuper Sandstone of Shrewley, Warwickshire, by the Rev. P. B. Brodie, M.A., F.G.S., who has kindly entrusted them to the present writer for study; and the following brief notes are suggested by an examination of the interesting new specimens.

Only four disconnected fragments of the dentition are preserved; but the general arrangement of the teeth is well shown and the finest example is figured of the natural size in Pl. XIV. fig. 1. Here are exhibited portions of three transverse series of teeth, disposed as in ordinary Cestracionts, the largest series measuring 0·01 in width and comprising six teeth, the next much smaller, measuring 0·008 in width and showing five teeth, and the third series still smaller and too imperfect for description. In one of the more fragmentary specimens (Pl. XIV. fig. 2), a series corresponding in size and characters to the second of Pl. XIV. fig. 1 exhibits traces of not less than eight teeth; and immediately adjoining this on one side are a few teeth similar to the largest in the first group, while on the opposite side are the bases of the teeth of a smaller series 0·005 in width. The crown in all the teeth is much compressed at right angles to the long axis, forming a sharp longitudinal keel; and the outer face is deeper than the inner face, the coronal apex being thus inclined inwards and overlapping to some extent the outer margin of the tooth within. Broken teeth also show a large internal cavity (Pl. XIV. fig. 2).

The coronal surface in all the teeth is marked by large transverse wrinkles, which are broadest or bifurcated at the outer and inner margins and attenuated towards the central

* Trans. Geol. Soc. [2] vol. v. (1840), pl. xxviii. fig. 3*.

crest, where short finer wrinkles are often intercalated. The form of the coronal crest, however, and the precise characters of the ornament evidently vary in different parts of the mouth, as indicated by the four enlarged figures (Pl. XIV. figs. 2 *a*, *b*, 3, 3 *a*); and in some teeth the superficial transverse wrinkles are so large at the extremities of the crown as to impart to the crest a serrated aspect.

In general form the tooth shown in Pl. XIV. fig. 3 has perhaps most resemblance to the Carboniferous fossils named *Venustodus* by St. John and Worthen*, the latter only differing in the smoothness of the sides of the coronal eminence; but the nature of associated remains suggests comparisons with other types possessing ornamented teeth. As already pointed out by Murchison and Strickland (*loc. cit.*), there occur upon the same horizon as the teeth ribbed dorsal fin-spines of the form first discovered in *Hybodus*; and such spines not having been met with in association with any teeth except those of *Hybodus* at the time of Murchison and Strickland's researches, the Keuper specimens received the name of *Hybodus keuperinus*. Agassiz, however, had already† founded the genus *Leiacanthus* upon similar spines from the French Muschelkalk on the erroneous supposition that they possessed no hinder denticles; and it is now known that ribbed spines of the same type also characterize *Acrodus*. Moreover, an example of the hooked cephalic spines, so well known in *Hybodus* and *Acrodus*, has been found with one of these dorsal fin-spines in the Keuper of Ripple, Worcestershire (Brit. Mus. no. 46957); and there is thus no improbability in the supposition that the teeth just described pertain to a Keuper representative of either *Hybodus* or *Acrodus*.

Taken alone the teeth are more suggestive of *Acrodus* than of *Hybodus*, and it is in the former genus that the present writer ventures to assign them a provisional position. At the same time it must be remembered that these teeth are not only more carinate than those of any typical species of *Acrodus*, but are also distinguished by the presence of a hollow cavity; and Dr. Otto Jäkel, of Strassburg, informs the writer that he will shortly propose to place all the hollow *Acrodus*-shaped teeth of the Trias in a distinct genus. The English Keuper fossils, indeed, are already named *Lophodus* in collections, though they do not appear to have been described under this name‡;

* Pal. Illinois, vol. vi. (1875), p. 344.

† Poiss. Foss. vol. iii. (1837), p. 55.

‡ The teeth are incidentally mentioned under this name by the Rev. W. S. Symonds, 'Old Bones' (1861), p. 103.

and even if it seemed advisable to scientifically establish the term, this is prevented by its preoccupation in the writings of Romanowsky * and Newberry and Worthen†.

Under any circumstances Mr. Brodie's discovery of the teeth in natural order is one of considerable interest; and the next desideratum is the actual proof of their connexion or otherwise with the ribbed fin-spines and hooked cephalic spines already mentioned.

2. On *Diplodus Moorei*, *sp. nov.*, from the Keuper of Somersetshire.

Extremely rare small teeth suggestive of the Carboniferous *Cladodus* also occur in the English Keuper; but still more remarkable is the discovery of teeth undistinguishable from the well-known Palæozoic *Diplodus*. There are nine examples of these teeth from Ruishton, near Taunton, in the collection of the late Mr. Charles Moore, F.G.S., in the Bath Museum, and through the kindness of the Rev. H. H. Winwood, M.A., F.G.S., the writer has recently had the pleasure of examining this fine series. All the teeth are approximately similar in form and proportions, and one is shown from the outer aspect in Pl. XIV. fig. 4, while another exhibits the inner aspect shown in Pl. XIV. fig. 5, both the figures being of twice the natural size.

Each tooth has a narrow, horizontally extended, depressed root, acutely rounded at its posterior or inner extremity, and a very large, oval, raised pad (or "button") occupies the anterior or outer portion of the root, both above and below, indicating the originally firm articulation of the successive teeth of the transverse series. The two cusps of the dental crown are short and stout, rounded in section, and very slightly divergent; and, though a definite keel is absent, the outer face of each cusp is sometimes marked by two or three vertical wrinkles in its superior portion. In well-preserved specimens there is also a minute denticle, occupying the usual position in the middle of the tooth (Pl. XIV. fig. 4).

In most known forms of *Diplodus* the coronal cusps are compressed and laterally keeled and thus very different from those of the Keuper teeth just described. It only seems necessary indeed to compare the new fossils with one species already established—*D. tenuis*, typically represented in the

* H. Romanowsky, Bull. Soc. Imp. Nat. Moscou, 1864, pt. ii. p. 160.

† Pal. Illinois, vol. iv. (1870), p. 360.

Coal-measures of Lanarkshire*. This form of tooth is distinguished from that of the Keuper by the less elongation of the horizontally extended root, the greater development of the median denticle, and the keeled apices of the coronal cusps; and Mr. Moore himself having recognized the affinities of the teeth under discussion, they may most appropriately receive the name of *Diplodus Moorei*.

The term *Diplodus* is, of course, only one of provisional value, and does not necessarily imply that the Keuper teeth pertain to the same genus as those of the Carboniferous and Permian, if, indeed, the latter belong to not more than one generic type. Some "species" certainly form the dentition of *Pleuracanthus*, and all probably pertain to fishes of the same primitive Elasmobranch group as this genus. Although no *Pleuracanth* spines have yet been found in the Keuper, *Diplodus Moorei* may thus imply that the typical members of Cope's Ichthyotomi had not become extinct in late Triassic times; but the discovery of skeletons must be awaited before so interesting a fact can be reasonably established.

3. On a Symmetrical Hybodont Tooth from the Oxford Clay of Peterborough.

The collection of Oxfordian Vertebrates made by Alfred N. Leeds, Esq., of Eyebury, Peterborough, has already furnished materials for the definition of one Mesozoic Selachian genus, *Asteracanthus*†; and it still comprises important novelties, elucidating other Selachian and Chimæroid genera of the same age. Among these fossils is a symmetrical Selachian tooth, shown of the natural size from the outer, inner, lateral, and inferior aspects in Pl. XIV. fig. 6.

This tooth exhibits a large median coronal cusp, erect and obtusely pointed, flanked in a symmetrical manner on either side by four small cusps, diminishing downwards and outwards. The entire crown is much inclined inwards, as shown in side-view; and this is fixed upon the anterior margin of a broad depressed base or root. The lower front edge of the latter is coarsely crimped, and its lateral margins are straight, somewhat converging behind, and forming well-marked angles with the hinder margin.

The specimen is probably referable to the symphysis of the jaw of one of the Hybodont sharks with high-crowned teeth,

* Smith Woodward, Cat. Foss. Fishes Brit. Mus. pt. i. (1889), p. 11, pl. vi. figs. 2-4.

† Smith Woodward, Ann. & Mag. Nat. Hist. [6] vol. ii. (1888), pp. 336-342, pl. xii.

which are still not capable of separation from the genus *Hybodus*; and the great interest of the tooth consists in the remarkable resemblance of its crown to that of the mandibular symphyseal tooth of some existing forms of *Notidanus* (e. g. *N. cinereus*). It is already known that the teeth of the Jurassic *Notidanus* can scarcely be distinguished from certain types ascribed to *Hybodus* *; and whatever may be its precise generic position, the new fossil just described adds one more to the observed points of similarity.

4. On a *Maxilla* of *Saurichthys* from the *Rhætic* of *Aust Cliff*, near *Bristol*.

The Rev. G. Hope Dixon, M.A., of Compton Greenfield, near Bristol, has kindly favoured the writer with the opportunity of studying a unique portion of a fossil jaw from the well-known Rhætic section of Aust Cliff. The specimen is well exposed, only one aspect being hidden by the hard matrix; and, as already recognized by Mr. Dixon, the teeth exhibited relegate it to the imperfectly known genus and species, *Saurichthys acuminatus*, Agassiz †.

The fossil is shown of the natural size, from the outer and inner aspect respectively, in Pl. XIV. figs. 7, 8; and a transverse section at the position of the dotted line in fig. 8 is given in fig. 8a. The alveolar border is almost straight; the external face of the bone curves slightly inwards above; and one extremity (presumably the hinder) is considerably deeper than the other. The whole of the outer aspect must have been originally ornamented with closely and irregularly arranged rounded tubercles of ganoine, of which considerable tracts are still preserved; and these tubercles are fewest near the superior margin. Externally the alveolar border exhibits the bases of a single series of small teeth, somewhat spaced, and not precisely uniform in size or arrangement; and within this series are two very large teeth, which evidently represent an inner row comprising few teeth at distant intervals. In this case there would be about eight outer teeth in the space between the positions of the two larger ones. In each of the last-named teeth the vertical carinæ are anterior and posterior, while the outer face is smooth; and there is a considerable difference in the proportions of the enamelled apex, that of the hinder tooth being relatively the longest and most slender.

* Smith Woodward, Geol. Mag. [3] vol. iii. (1886), p. 257, pl. vi. figs. 1, 2.

† Poiss. Foss. vol. ii. pt. ii. (1843), p. 86, pl. 55 a. figs. 1-5.

The inner aspect of the fossil (Pl. XIV. fig. 8) is most interesting, as exhibiting a large plate of bone directly continuous with the lower portion of the outer ascending lamina, but lying in an almost horizontal plane. So far as preserved, this plate is very thick and broadest anteriorly (fig. 8 a); and, taking all points into consideration, it seems clear that the specimen in question is a left maxilla, while this represents an inner palatal extension.

Such being the case, the maxilla of *Saurichthys* exhibits a palatal plate as large as that of many Amphibia and Reptilia; but the genus cannot, on that account, be excluded from the Pisces, the maxilla in some early types (e. g. *Polypterus* *) being known to possess a considerable palatal ingrowth. Discoveries of the skull and mandible on the continent †, indeed, prove that *Saurichthys* was a long-snouted fish, bearing a close relationship to *Belonorhynchus*; and it is interesting to note that these fossils, like that now described, are externally ornamented with fine tubercles. Moreover, the teeth upon the maxilla of *Belonorhynchus* are arranged exactly as in the Aust specimen, as shown by a Liassic skull in the British Museum (no. P. 428); and it still remains for future discoveries to make known the generic differences (if any) between the two early Mesozoic forms just compared.

EXPLANATION OF PLATE XIV.

Fig. 1. *Acerodus keuperinus* (Murch. & Strickl.); naturally arranged teeth.—Upper Keuper; Shrewley, Warwickshire. Collection of the Rev. P. B. Brodie, M.A., F.G.S., Rowington Vicarage, Warwick.

Fig. 2. Ditto; naturally arranged teeth.—Ibid. Same collection.

Figs. 2 a, b. Ditto; two teeth of the last specimen, outer aspect, twice nat. size.

Figs. 3, 3 a. Ditto; tooth, outer and coronal aspects, twice nat. size.—Ibid. Same collection.

Figs. 4, 5. *Diplodus Moorei*, sp. nov.; two teeth, outer and inner aspects, twice nat. size.—Keuper; Ruishon, near Taunton. Moore Collection, Bath Museum.

Figs. 6 a-c. Symmetrical Hybodont tooth; outer, inner, lateral, and inferior aspects.—Oxford Clay, Peterborough. Collection of Alfred N. Leeds, Esq., Eyebury, Peterborough.

Figs. 7, 8, 8 a. *Saurichthys acuminatus*, Agass.; left maxilla, outer and inner aspects and section.—Rhætic; Aust Cliff. Collection of the Rev. G. Hope Dixon, M.A., Compton Greenfield Rectory, Bristol.

[Unless otherwise stated, the figures are of the natural size.]

* R. Owen, 'Anatomy of Vertebrates,' vol. i. p. 118.

† H. von Meyer, *Palæontogr.* vol. i. (1849), p. 201, pl. xxxi. figs. 29-32; K. Martin, *Zeitschr. deutsch. geol. Ges.* vol. xxv. (1873), p. 725, pl. xxii. figs. xiv, xv (*Stylorhynchus*).

XXXIII.—*On the Reptiles and Batrachians obtained in Morocco by M. Henry Vaucher* *. By G. A. BOULENGER.

FOR the last few years M. H. Vaucher, established in Tangier, has been collecting Reptiles and Batrachians for the British Museum. Himself interested in zoology, he has taken care to send whatever specimens appeared to him new or interesting, together with representatives of the commoner species; so that the following account may be regarded as referring to all the forms which M. Vaucher has come across in the district where he resides.

Where not otherwise stated the Reptiles enumerated in the following list are from the vicinity of Tangier and are preserved in the British Museum.

REPTILIA.

LACERTILIA.

1. *Tarentola mauritanica*, L.
2. *Agama Bibronii*, A. Dum.
3. *Trogonophis Wiegmanni*, Kaup.
4. *Lacerta ocellata*, var. *tangitana*, Blgr.

Since the description of this interesting form appeared five more specimens have been sent, bringing the number up to eleven, which present the following variations in the number of scales and femoral pores:—

| | Scales across the middle of the body. | Transverse rows of ventrals. | Transverse rows of gular scales. | Femoral pores. |
|--------------------|---|------------------------------------|--|-------------------|
| 1. ♂, type | 96 | 31 | 26 | 18—18 |
| 2. ♂ " | 83 | 29 | 25 | 18—17 |
| 3. Yg. " | 90 | 28 | 28 | 18—19 |
| 4. Yg. " | 100 | 30 | 28 | 18—19 |
| 5. Yg. " | 95 | 30 | 28 | 18—19 |
| 6. Yg. " | 80 | 29 | 27 | 18—18 |
| 7. ♂ | 89 | 29 | 27 | 17—17 |
| 8. ♂ | 78 | 30 | 24 | 18—17 |
| 9. ♂ | 80 | 29 | 26 | 19—21 |
| 10. ♀ | 77 | 32 | 26 | 19—18 |
| 11. Hgr. | 86 | 30 | 26 | 18—18 |

* For the latest account of the herpetological fauna of Morocco the reader is referred to Dr. O. Boettger's important paper in Abh. Senck. Ges. 1883.

5. *Lacerta muralis*, Laur.

In every respect undistinguishable from Spanish and Portuguese specimens.

6. *Psammodromus microdactylus*, Bttg.

The number of specimens sent by M. Vaucher now amounts to twenty-one. In addition to these I have also examined two from Mogador, collected by Lieut. Quedenfeldt and kindly sent to me for the British Museum by Prof. F. E. Schultze. I am thus enabled to draw up the following supplementary notes on this little-known species, which has not hitherto been found out of Morocco.

The number of femoral pores varies from 10 to 13 on each side, the usual number being 12. The coloration of the upper parts in fresh specimens varies from pea-green to olive, with or without brown or black spots, which may be mixed with white, as in *P. hispanicus*; a more or less distinct brown or reddish lateral band is constantly present; lower surfaces white, outer row of ventrals lemon-yellow; throat of males bluish. Young with small black and white ocelli on the sides; upper lip pure white; a pure white black-edged streak from the eye to above the tympanum and a second from the angle of the mouth through the lower half of the tympanum to the axil.

7. *Psammodromus algirus*, L.8. *Acanthodactylus vulgaris*, var. *lineomaculatus*, D. & B.9. *Chalcides ocellatus*, Forsk.

The specimens, four in number, sent by M. Vaucher from Tangier belong to the colour-variety which I have designated as var. C in the 'Catalogue of Lizards.' The upper surfaces are bronzy brown above, without any spots, except in some specimens a small basal margin to each scale, and with a light pale brown or golden upper and a black lower lateral band; lips with black and white tessellation. They have 32 scales round the body. I may here remark that a specimen from Assab, collected by Dr. Ragazzi and recently communicated to me by the Marquis Doria, has only 24 scales round the body; it differs from the typical form (A) only in the absence of ocelli on the back. The variation in the number of longitudinal rows of scales therefore ranges from 24 to 38 in this species.

10. *Chalcides lineatus*, Leuck.

The Algerian "Seps" belonging to the Italian species *C. tridactylus*, it is interesting to find the form of Tangier to be referable to the Western species *C. lineatus*, previously known only from the South of France and the Spanish peninsula. The three specimens sent by M. Vaucher present the following characters:—

- A. Hind limb contained 15 times in the length of head and body (from snout to vent 135 millim.; hind limb 9). 24 scales round the body. 9 dark streaks along the back, as broad as the interspaces between them.
- B. Hind limb contained 15 times in the length of head and body (from snout to vent 120 millim.; hind limb 8). 24 scales round the body. Uniform bronzy olive.
- C. Hind limb contained 14 times in the length of head and body (from snout to vent 97 millim.; hind limb 7). 24 scales round the body. Uniform bronzy olive.

In two of the specimens the hind limb is thus seen to be slightly shorter than in any European example which has yet come under my notice; in these its length is comprised from 12 to 14 times in the length of head and body. These Moroccan specimens also differ from the European, as well as from *C. tridactylus*, in having the ear-opening somewhat larger.

11. *Chalcides mionecton*, Bttg.

A single specimen, otherwise typical, is of particular interest from the feet being penta- instead of tetradactyle. The fifth toe is, it is true, short and clawless, but nevertheless perfectly distinct.

OPHIDIA.

12. *Coronella Amaliæ*.

Rhinechis Amaliæ, Boettg. Zool. Anz. 1881, p. 570, and Abh. Senck. Ges. xiii. 1883, p. 98, pl. i. fig. 1.

Two specimens, from the Benider Hills, one of which has been kindly compared with the type of *Rhinechis Amaliæ* by my friend Dr. Boettger.

Snout prominent; rostral as long as broad, produced posteriorly between the internasals, the portion seen from above about half as long as its distance from the frontal; suture between the internasals one third the length of that between

the præfrontals; frontal a little longer than its distance from the end of the snout, a little shorter than the parietals; loreal longer than deep; a single præocular; two postoculars; temporals 2+3; eight upper labials, fourth and fifth entering the eye; four lower labials in contact with the anterior chin-shields; posterior chin-shields three fourths the length of the anterior. Scales in 21 rows. Ventrals 190-193; anal divided; subcaudals 63-64. Grey-brown above, with reddish-brown spots and four rather indistinct dark longitudinal bands; vertebral region light; a pair of elongate dark brown spots on the nape; a black streak on each side of the head, from the nostril, through the eye, to the angle of the mouth; a dark cross band between the eyes, crossing the præfrontals; a black line below the eye, on the suture between the fourth and fifth upper labials. Lower surfaces coral-red, with quadrangular black spots.

Total length 39 centim.; tail 72.

This species is intermediate between *C. austriaca* and *C. girondica*, agreeing with the former in the size and shape of the rostral shield, with the latter in the number of upper labials, the scaling of the body, and the coloration of the lower parts.

13. *Tropidonotus viperinus*, Daud.

14. *Zamenis hippocrepis*, Merr.

15. *Cælopeltis lacertina*, Wagl.

16. *Psammophylax cucullatus*, Geoffr.

A single specimen, with 21 rows of scales, 173 ventrals, and 49 subcaudals. Belly with small black spots.

CHELONIA.

17. *Clemmys leprosa*, Schw.

BATRACHIA.

ECAUDATA.

1. *Rana esculenta*, var. *ridibunda*, Pall.

Entirely agrees with the Spanish and Portuguese frog, which I likewise refer to *R. ridibunda*.

The following are measurements of four female specimens from Tangier:—

| | <i>a.</i> millim. | <i>b.</i> millim. | <i>c.</i> millim. | <i>d.</i> millim. |
|--|----------------------|----------------------|----------------------|----------------------|
| From snout to vent..... | 85 | 69 | 69 | 65 |
| Length of tibia | 45 | 37 | 35 | 35 |
| Length of foot (from outer metatarsal tubercle)..... | 45 | 37 | 34 | 34 |
| Length of inner toe | 13 | 11 | 10 | 10 |
| Length of inner metatarsal tubercle | 4 | 3 | 3 | 3 |

2. *Bufo mauritanicus*, Schleg.

3. *Hyla arborea*, var. *meridionalis*, Bttg.

4. *Discoglossus pictus*, Otth.

CAUDATA.

5. *Salamandra maculosa*, var. *algira*, Bedr.

Numerous specimens from the Benider Hills.

Spots few, roundish, and forming a single straight or zigzag series on the back instead of being in pairs as is usually the case in this species. The spots are usually arranged as follows: one on each eyelid, one on one of the parotoids, right or left, from three to five on the body, one at the base of each limb, and a few on the tail. With regard to the proportions, they agree with Algerian specimens.

In the following table I give the dimensions of four Salamanders from Morocco (*a-d*) and of two from Oporto (*e, f*) for comparison:—

| | <i>a.</i> millim. | <i>b.</i> millim. | <i>c.</i> millim. | <i>d.</i> millim. | <i>e.</i> millim. | <i>f.</i> millim. |
|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| From snout to vent.. | 86 | 73 | 62 | 47 | 73 | 54 |
| Tail | 77 | 65 | 55 | 43 | 58 | 39 |
| Third toe | 8 | 6.5 | 5 | 4 | 6 | 5 |
| Fifth toe | 3 | 3 | 2 | 2 | 2 | 1.5 |

This is the first record of *S. maculosa* in Morocco.

6. *Molge Waltlii*, Michah.

Charf-la-Kaab, 10 miles from Tangiers.

XXXIV.—Description of a new *Batrachian* of the Genus *Eupemphix* from *Trinidad*. By G. A. BOULENGER.

Eupemphix trinitatis.

Head small; snout prominent, much shorter than the diameter of the orbit, with vertical lores; interorbital space a

little broader than the upper eyelid; tympanum scarcely visible. Fingers slender, with slightly swollen tips, first as long as second; toes moderate, free; subarticular tubercles very prominent; two oval metatarsal tubercles; a small tubercle on the middle of the inner edge of the tarsus. The tibio-tarsal articulation reaches the eye or the posterior border of the orbit, the tarso-metatarsal articulation the tip of the snout or a little beyond. Upper surfaces warty, the warts sometimes confluent into four longitudinal folds, viz. a pair from the snout to the nape and one on each side from behind the eye to the sacral region; a well-developed triangular parotoid, low down on the side, behind the tympanum and above the shoulder; no lumbar gland; lower surfaces granulate. Greyish olive above, head and sides sometimes paler; a light vertebral line may be present; upper lip with two or three vertical dark bars; limbs with dark cross bars; throat and breast brown, with a white median line; belly whitish, with small brown spots. Male with a large external vocal sac on each side of the throat and brown rugosities on the inner side of the inner finger.

From snout to vent 30 millim.

Two males and two females were presented to the British Museum by Mr. J. H. Hart, Superintendent of the Royal Botanic Gardens, Trinidad. "They are very seldom seen and generally discovered only when half drowned in a fountain or similar place in the Gardens, where they go to spawn."

XXXV.—Notes on the Genus *Lobiger*.

By EDGAR A. SMITH.

THE British Museum received in 1887 from Mr. Edgar Thurston, of the Madras Museum, a number of interesting specimens from Tuticorin, Southern India, and among them were two examples of a species of *Lobiger*. On comparing the shells with those of the Sicilian species, which is generally known under the name of *L. Philippii*, I could discover no sufficient differences of form or sculpture whereby to distinguish them, and, with the exception of the mantle of the Ceylonese specimens being striped with interrupted fine black lines, which are visible through the shell, there appears to be no appreciable difference in the soft parts.

In describing this animal Calcara does not mention the characteristic lateral lobes of the foot, and states that this organ is obtuse at both extremities and that the posterior is

covered by the shell. This is the case with three Sicilian specimens in the Museum and the two examples from Ceylon. None exhibit parapodia, and all have the foot sharply truncate behind, so that I am of opinion that this animal has not only the power of casting off the lateral lobes, as described by Krohn, but also, like the genera *Harpa* and *Gena*, is able spontaneously to detach the hinder portion of the foot.

Not one of the five specimens has the parapodia remaining, so that it must be concluded that they have either been cast off or have not been developed. The character of the cephalic or tentacular lobes is quite the same in all; the sides of the foot are more or less tubercular, and, when closely examined, are seen to be minutely speckled.

I have extracted the odontophore from one of the Ceylonese specimens and find that it corresponds precisely with the figure given by Vayssière of that of *L. Philippii*.

From the similarity of habitat I conclude that the two specimens sent by Mr. Thurston belong to *L. viridis* of G. and H. Nevill. Beyond difference of locality and the interrupted linear markings on the mantle there appear to be no distinguishing features in this so-called species.

I have made tracings of all the figures which have appeared of the different species of the genus, and, on comparison, it is curious to note what slight variation exists in the shells; indeed, taking the figures which represent *L. Serradifalci*, one may observe more difference of outline among them than between some of them and the other so-called species. Allowing for alteration of form in respect of size and age, I cannot discover valid conchological distinctions in any of the species.

In the British Museum a specimen from Sicily received from the late Robert MacAndrew curiously enough more nearly resembles the figure given by Pease of *L. pictus* from the Society Islands than any other.

Below is given the synonymy of all the described species. *Lobiger Cumingii*, A. Adams*, as pointed out by G. and H. Nevill†, should be removed to the genus *Volvatella* of Pease.

Lobiger Serradifalci (Calcara).

1840. *Bullea*? *Serradifalci*, Calcara, Monogr. *Clausilia* &c. p. 44.

1845. *Dolabella Serradifalci*, Calcara, Rev. Zool. p. 280.

* Thesaurus Conch. vol. ii. p. 399, pl. cxxi. fig. 58.

† Journ. As. Soc. Beng. 1869, vol. xxxviii. pt. 2, p. 66.

1847. *Lobiger Philippii*, Krohn, Ann. Sci. nat. sér. 3, Zool. vol. vii. p. 52, pl. ii. figs. 1-4 (animal and shell).
 1850. *Lobiger Philippii*, Souleyet, Journ. de Conch. vol. i. p. 232, pl. x. figs. 13, 14 (shell).
 1850. *Lobiger Philippii*, A. Adams, in Sowerby's Thesaur. Conch. vol. ii. pp. 598 and 602, pl. cxix. fig. 18 (animal), pl. cxxi. fig. 57 (shell).
 1856. *Lobiger Philippii*, Fischer, Journ. de Conch. vol. v. p. 274.
 1858. *Lobiger Philippii*, H. & A. Adams, Gen. Moll. ii. p. 31, pl. lix. figs. 2, 2 a (animal and shell).
 1853. *Lobiger Philippii*, Philippi, Handbuch Conch. und Malacol. p. 227.
 1854. *Lobiger pellucidus*, A. Adams, Proc. Zool. Soc. 1854, p. 94.
 1854. *Lobiger Philippii*, Woodward, Man. Moll. p. 186, pl. xiv. fig. 16 (shell).
 1856. *Lobiger pellucidus*, Fischer, Journ. de Conch. vol. v. p. 274.
 1858. *Lophocercus pellucidus*, H. & A. Adams, Gen. Moll. vol. ii. p. 31.
 1859. *Lobiger Philippii*, Chenu, Man. Conch. p. 394, figs. 2993, 2994 (animal and shell).
 1859. *Lobiger Philippii*, Gray, Fig. Moll. vol. iv. pl. clxxvi. figs. 1, 1 a (animal), fig. 1 b (shell).
 1863. *Lobiger Philippii*, Mörch, Journ. de Conch. vol. xi. p. 47.
 1863. *Lobiger corneus*, Mörch, l. c. p. 48.
 1863. *Oxynoë pellucidus*, Mörch, l. c. p. 46.
 1868. *Lobiger Philippii*, Weinkauff, Conch. Mittelm. vol. ii. p. 180.
 1868. *Lobiger Philippii*, Pease, Am. J. Conch. vol. iv. p. 75.
 1869. *Lobiger Philippii*, Petit de la Saussaye, Cat. Moll. test. mers d'Europe, p. 265.
 1870. *Lobiger Serradifalci*, Aradas & Benoit, Conch. Viv. Mar. Sicil. p. 138.
 1878. *Lobiger Philippii*, Kobelt, Illust. Conchylienb. p. 176, pl. lix. fig. 29 (shell).
 1883. *Lobiger Philippii*, Tryon, Syst. Struct. Conch. vol. ii. p. 363, pl. lxxxix. figs. 65, 66 (animal and shell).
 1883. *Lobiger Philippii*, Fischer, Man. Conch. p. 571, pl. xiv. fig. 16 (shell).
 1885. *Lobiger Philippii*, Vayssière, Ann. Mus. Hist. Nat. Marseille, vol. ii. mém. 3, pp. 100-102 and 177, pl. ii. figs. 48-50 bis (animal, radula, and shell).

Hab. Sicily (*Calcara*, *Krohn*, and others); Gulf of Marseilles (*Vayssière*).

It has been pointed out by Petit in the first instance, and afterwards by Aradas and Benoit, that the *Bulca Serradifalci*, named by *Calcara* in honour of the Duke of Serradifalco (a small town in Sicily), is the same as *L. Philippii* of *Krohn*, and I am of opinion that this identification is correct.

L. pellucidus of A. Adams, described without locality and from shell-characters only, is not to be separated from the present species. The types in the Museum show this, and consequently prove that the brothers Adams, and Mörch after them, were wrong in referring the species to *Lophocercus* or *Oxynoë*.

L. corneus of Mörch has still slighter grounds to rank as a distinct species, being founded upon the figures of Adams and Woodward of *L. Philippii*. Why Mörch thought that those figures did not correctly represent the Mediterranean species it is impossible to say; I can only remark that on comparing them with Sicilian shells they more closely resemble them than do some of the figures which are admitted by Mörch to illustrate the true *L. Philippii*.

Lobiger viridis, G. & H. Nevill.

1869. *Lobiger viridis*, G. & H. Nevill, J. As. Soc. Bengal, vol. xxxviii. pt. 2, p. 68, pl. xiii. figs. 6-6 b (shell).

Hab. Ceylon (G. & H. Nevill), Tuticorin, Southern India (Thurston).

Differs only from *L. Serradifalci* in having the mantle ornamented with interrupted fine black lines.

Lobiger Souverbii, Fischer.

1856. *Lobiger Souverbii*, Fischer, Journ. de Conch. vol. v. p. 273, pl. xi. figs. 7-10 (animal and shell).

Hab. Guadeloupe.

This species (?) is distinguished by the presence of a single lobe on each side, that on the right being situated more forward than that on the left. The shell offers no tangible differences from that of the Mediterranean species. Considering how uncertain are the presence and number of the parapodia, there seem to be insufficient grounds shown at present for specifically separating this form from *L. Serradifalci*.

Lobiger (Pterygophysis) pictus (Pease).

1868. *Lobiger pictus*, Pease, Am. Journ. Conch. vol. iv. p. 75, pl. viii. fig. 3 (animal), and pl. xii. fig. 26 (shell).

1871. *Lobiger pictus*, Martens & Langkavel, Don. Bismark. p. 54, pl. iii. fig. 5 (shell).

1883. *Lobiger (Pterygophysis) pictus*, Fischer, Man. Conch. p. 570 (animal).

Hab. Huaheine, Society Islands.

This species, according to Pease, has two instead of a single pair of tentacles and is differently coloured from the Sicilian form. The shell appears to be similar in both.

XXXVI.—*Descriptions of ten more new Species of Butterflies captured by Mr. John Whitehead at Kina Balu Mountain, North Borneo.* By H. GROSE SMITH.

IN addition to the six new species described by me in the December part, 1887, of the Ann. & Mag. Nat. Hist., Mr. Whitehead, on his return to England last year, brought the following new species of butterflies captured by him in the above-mentioned locality.

Delias eumolpe.

Male.—*Upperside.* Both wings pure white. Anterior wings with the apical third, costa, and base greyish black, the apical black area indented inwardly and with three minute greyish-white spots between the discoidal and two upper median nervules. Posterior wings with the outer margins and ends of the veins narrowly black.

Underside. Anterior wings greyish black except on the inner margin, which is white, and the area below and extending somewhat beyond the cell, which is irrorated with white scales; a large, oblong, oblique, greyish-white spot at the end of and extending slightly above and beyond the cell, broadest at the upper end; near the apex a curved row of five conical spots, the four upper spots yellow, the fifth yellowish white, the first spot below the subcostal nervule, the second minute, the third the largest, the fourth about the same size as the first, the fifth the smallest, followed near the margin by two short white lines between the two lowest median nervules, and two similar lines on the margin close together above the submedian nervure. Posterior wings bright yellow, with a broad marginal black band and black veins; in the band is a submarginal row of six red triangular spots between the veins, the uppermost situate below the first subcostal nervule; a basal, broad, elongated red patch below the costal nervure; the costa at the base irrorated with yellow.

Expanse of wings $3\frac{1}{2}$ inches.

Nearest to *D. Descombesi*, Boisd., and *D. belisama*, Cr.

In the collections of Mr. Whitehead and Mr. Grose Smith.

Cyrestis seminigra.

Upperside. Both wings white, with black veins, and crossed with brown-black bands. Anterior wings with a small brown

spot near the outer angle narrowly bordered internally with white, and with one small black spot a little above its centre; at the top of the brown spot is a larger black spot narrowly edged with white, and above this spot between the two lowest median nervules, each of which it touches, is an elongate quadrate spot narrowly edged with white. Posterior wings with a brown patch at the anal angle in which are several black spots; an oval black spot narrowly surrounded with white on the abdominal fold above the brown patch.

Underside as above, but paler.

Near to *C. mænalis*, Erichs., and *irmæ*, Forbes, but differs from both chiefly in being white and black instead of stramineous and brown; the transverse bands are broader, and in the brown spot at outer angle of anterior wings, which is smaller than in either of those species, there is only one instead of two black spots. Mr. Forbes, in describing *C. irmæ* ('A Naturalist's Wanderings in Sumatra,' p. 274), appears to have transposed the description of this butterfly with the description of *Cethosia caroline*; his description of the latter applies to *Cyrestis irmæ*, and the description of *Cyrestis irmæ* applies to *Cethosia caroline*.

Expanse of wings $1\frac{1}{2}$ inch.

In the collections of Mr. Whitehead and Mr. Grose Smith.

Euthalia Whiteheadi.

Male.—Upperside. Anterior wings dark brown, the costal margin, apex, and a rather broad outer marginal space tinged with olivaceous green, slightly iridescent, especially towards the outer angle; three dark brown bars across the cell, a small oblong white spot between the basal and middle bar on the subcostal nervure, a narrow, oblong, slightly curved, greyish-white spot immediately beyond the third bar, a fourth bar on the discocellular nervule, and a fifth beyond, the space between the fourth and fifth slightly iridescent olive-green; two rows of three white spots each beyond, converging above the upper median nervule; near the costal margin, between the rows, is one white spot; in the disk, on each side of the lowest median nervule, is a curved, rather narrow, indistinct, whitish-brown marking. Posterior wings: basal three fourths dark brown, outer fourth iridescent dark olivaceous green, in the middle of which is a row of seven black conical spots, the anal spot double, the three upper spots edged externally with three carmine spots; three larger carmine spots towards the middle, the uppermost below the costal nervure, the other two

below the first and second subcostal nervules; an indistinct small red spot near the anal angle.

Underside. Both wings paler and greener than above. Anterior wings with the bars across and beyond the cell as above, the space between the second and third and fourth and fifth bars carmine, the white spots as above; two greyish-white patches, edged internally with brownish black on each side of the lowest median nervule; a rather broad whitish-green space on the outer margin, lightest towards the outer angle, becoming obsolete towards the apex, edged internally with brownish black. Posterior wings with the red spots as above; the submarginal row of black conical spots almost obsolete; across the disk below the lowest red discal spot is a double row of lunular brown markings, the usual basal markings centred with carmine; base of the costa narrowly carmine.

Female.—*Upperside.* Paler than the male. Anterior wings crossed about the middle with an oblique white band of four spots: the uppermost crosses the cell, indented on each side; the second at the junction of the middle median nervule with the median nervule, minute; the third between the second and lowest median nervules, narrowly elongated outwardly at its lower end along the latter; the fourth below it smaller and lunulate. Instead of the two converging rows of three white spots in the apical portion of the male wing, the outer row has two spots only, and there is one spot on the costa.

Underside as above, but paler; the anterior wings have a small annular spot below the cell, which is absent in the male. Posterior wings: the two lowest discal carmine spots are represented by two pale whitish-pink patches, edged internally with dark brown, beneath which, bending towards the anal angle, is a double row of lunular markings; the carmine spots within the basal markings are smaller, several being nearly obsolete.

Expanse of wings, ♂ $3\frac{1}{4}$, ♀ $3\frac{1}{2}$ inches.

The male is in the collections of Mr. Whitehead and Mr. Grose Smith, the female is in the collection of Mr. Whitehead only.

Nearest to *E. lubentina*, Cramer, but in the shape of the wings, the position and number of the white markings on the anterior wings of both sexes, and the size differing from that species. It also differs from *E. djata*, Distant, with the types of which it has been compared and in which the white spots in the apical portion of the anterior wings are absent; and in the female *E. djata* the white band of spots on the anterior

wings are transverse and different in numerous respects. In *E. Whiteheadi* there are no red lines or markings on the abdominal margin of the posterior wings of either sex.

Tanæcia amisa.

Male.—Upperside. Both wings dark velvety brown, crossed in the middle by a pure white band. On the anterior wings the band on the costa is only represented by a narrow short line; thence to the inner margin the band gradually widens, the veins across the band brown; a very indistinct, somewhat curved, white line between the subcostal nervules half-way between the band and the apex; the cell is crossed by five black lines, the two outermost nearly joining each other on the median nervure; between the lowest median nervule and the submedian nervure, near the base, touching the cell at their upper ends, are two transverse black lines crossed at their lower ends by a similar line; a small black spot below the cell between the lowest and middle median nervule; a submarginal row of indistinct, rather large, black spots. On the posterior wings the band gradually tapers towards the anal angle, where it slightly curves outwardly; the outer edge of the band is slightly indentated; an indistinct submarginal row of round black spots.

Underside. The band as above; pale brown inside the band, darker beyond it; the band is edged on both sides with dark brown markings; the subapical, indistinct, curved white line on the upperside is represented by two white spots near the costa and indistinct whitish-brown markings inside the submarginal row of dark brown spots, the lines across the cell and beneath it as above. Posterior wings brownish grey between the band and the base, with numerous brown markings; the area beyond the band is pale brown, with a submarginal row of dark brown spots capped with whitish lunules, above which is a series of lunular brown markings; the outer portion of the band above the latter narrowly grey.

Expanse of wings $3\frac{1}{4}$ inches.

Nearest to *T. cibaritis* and *T. acontias* of Hewitson.

In the collection of Mr. Whitehead.

Tanæcia cærulescens.

Male.—Upperside. Both wings brown, with dark markings in the cell and basal area. Anterior wings with a greyish-blue marginal band intersected by the brown nervules, commencing narrowly below the upper median nervule, gradually

widening towards the posterior angle. Posterior wings broadly margined with a band of the same colour, dentated on the inner edge; above the middle of the band is a row of small spots between the veins as far as the lowest median nervule, the two uppermost becoming larger and hastate.

Underside. Anterior wings pale brown at the base, gradually becoming darker towards the middle, whence to the outer margin the wings are suffused with bluish grey, tinged with pink and slightly iridescent; a submarginal row of hastate dark markings commencing below the costa, larger towards the posterior angle; inside the submarginal row is another row of lunular spots capped with dark markings; the usual markings across and beneath the cell. Posterior wings: basal third pale brown tinged with bluish grey, the rest of the wings bluish grey, more iridescent than the anterior wings; a submarginal row of hastate markings, inside which, a little beyond the middle, is a row of lunular markings; the usual spots and markings towards the base.

Expanse of wings $2\frac{1}{4}$ inches.

Nearest to *T. supercilia*, Butler.

In the collections of Mr. Whitehead and Mr. Grose Smith.

Tenaris occulta.

This species is near *T. Horsfieldii*, Swainson, but differs from it in the following respects:—

Male.—*Upperside.* The anal third of the posterior wings is wholly pale brownish white, instead of being margined with the same colour as the rest of the wings, the basal area being darker than in *T. Horsfieldii*.

Underside. The outer half of the posterior wings, in which the ocelli are situated, is pale brownish white, except a space near the apex, which is irrorated with dusky brown; the rest of the posterior wings is dark brown, the outer edge of which colour does not extend to the ocelli, but forms two distinct curves partially round them, leaving on the inner side of the upper ocellus a narrow, and of the lower ocellus a broader area of the same colour as the outer portion of the wings.

Female.—*Upperside* paler than in the male, and the lower ocellus on the posterior wings is entirely surrounded by the brownish-white colour of the anal area.

Underside. The outer two thirds of the posterior wings is pale brownish white, the basal third dusky brown, which colour does not extend as far towards the ocelli as it extends in the male. The posterior wings are narrower than in the male.

Expanse of wings, ♂ $3\frac{1}{8}$, ♀ $2\frac{7}{8}$ inches.

In the collections of Mr. John Whitehead and Mr. Grose Smith.

Elymnias kongra.

Male.—*Upperside.* Both wings dull bluish slate-colour, changing to dull brown on the margins; outer margins emarginate.

Underside. Both wings dull brown, darker towards the base and mottled with brownish-grey markings. Anterior wings with several light grey markings on the costal margin towards the apex and an indistinct light grey area from the apex to near the middle. Posterior wings with a rather small white spot a little below the costal margin near the middle, halfway between which and the base is an indistinct rufous patch, the apex slightly rufous.

Expanse of wings $2\frac{3}{4}$ inches.

In the collection of Mr. Whitehead.

Near to *E. penanga*, Hewitson, and *E. sumatrana*, Wallace; but, besides other differences, the apex of the anterior wings is less acute; it has a subcostal white spot on the underside of the posterior wings which is absent in those species, and the outer margins are emarginate.

Sithon teunga.

Male.—*Upperside.* Anterior wings dull brown, with the inner margin projecting; a round, depressed, sericeous spot above the submedian nervure about the middle. Posterior wings: anal third white, the veins across the white area black, rather broadly tipped with black on the margin; the upper half smooth, devoid of scales; two tails, that nearest the anal angle the longest.

Underside. Both wings dull pale brown, darker towards the apex and almost white at the anal angle; the inner marginal third of the anterior wings smooth, with a tuft of pale brown hairs. Posterior wings: outer margin narrowly black, a round black spot at the anal angle, another and two black bars in a row above it, and inside these is another row of three sinuate black elongated spots.

Expanse of wings $1\frac{1}{2}$ inch.

In the collection of Mr. Whitehead.

Somewhat resembles *S. amrita*, Feld., on the underside.

Sithon kiana.

Male.—*Upperside.* Anterior wings dark brown. Posterior

wings : basal and costal third dark brown, the remaining part light blue, shading to white towards the anal angle, at which there is a black spot ; an oval black spot between the lowest and middle median nervule ; one white tail, margin narrowly black ; cilia white, spotted with black at the tips of the veins.

Underside. Anterior wings rufous-orange, a rather broad rufous band on the outer margin ; inner margin narrowly grey ; an indistinct short white line, edged externally with brown near the outer angle at the inner edge of the rufous band ; an indistinct, interrupted, transverse grey line beyond the middle, becoming obsolete towards the costa. Posterior wings rufous-orange, the apical third of the margin rather broadly rufous, below which to the anal angle there is a rather broad marginal white band, narrowly black on the margin, in which, at the anal angle, is a black spot ; beyond the tail is another black spot crowned with a brown bar, and connected with the anal spot by two narrow dark brown bars, and two smaller black spots beyond, the first of which has a narrow brown bar above it ; above the spots and bars and extending nearly to the apex are a row of lunular white markings, edged narrowly with brown, and towards the middle an indistinct V-shaped white line.

Female.—*Upperside* as in the male, but paler ; the blue area on the posterior wings is narrower and greyer, with a submarginal row of five ill-defined black spots, the middle and anal spots being the largest.

Underside as in the male, but posterior wings paler and yellower.

Expanse of wings, ♂ $1\frac{1}{8}$, ♀ $1\frac{1}{4}$ inch.

Nearest to *S. tharis*, Hübn., and *S. Meduana*, Hew.

In the collections of Mr. Whitehead and Mr. Grose Smith.

Sithon cineas.

Male.—*Upperside.* Anterior wings dark blue, base and costa narrowly, outer margin broadly, black, the inner margin towards the base projecting. Posterior wings rather brighter blue, the lower part of the outer margin strongly emarginate, with three black tails tipped with white, the middle tail much the longest ; a black band on the margins, broadest above the tails ; a narrow white line between the two lowest tails, and above it and the black band is a rather broad brownish-white spot, broadest next the abdominal fold ; a faint indication across the middle of the black line on the underside ; on the costal margin a broad shiny patch devoid of scales.

Underside. Anterior wings dull brownish white at the base, gradually becoming greyish brown at the apex and outer margin. Posterior wings brownish white, with a submarginal band from the apex to the anal angle, brown at the apex, changing to black above the tails, and at the anal angle centred with a thin metallic blue line; above the submarginal band is a second slightly irregular band, brown and linear near the apex, changing to black and broader towards the anal angle; cilia white.

Female.—Upperside. Both wings entirely brown except the narrow white line between the two tails on the posterior wings and a small white spot above the anal angle.

Underside as in the male.

Expanse of wings, ♂ $1\frac{1}{4}$, ♀ $\frac{7}{8}$ inch.

Nearest to *S. cinesia* and *S. manea*, Hewitson.

The female is smaller than the male, a peculiarity noted by Mr. Hewitson with regard to *S. cinesia*.

In the collection of Mr. Whitehead.

XXXVII.—*The Staphylinidæ of Japan.*

By Dr. D. SHARP.

[Continued from p. 267.]

EOMEDON, nov. gen.

Corpus minus elongatum, subconvexum, hirtellum. Labrum rotundatum, medio emarginatum. Caput collo angusto. Prosternum breve. Tarsi posteriores articulo quarto sub quinto producto.

Labrum large, elongate, with a slight emargination in the middle, but no trace of denticles. Mandibles short, rather strongly bidentate in the middle. Penultimate joint of maxillary palpi rather inflated, globose-oval. Anterior tarsi slightly dilated. Prosternum in front of the coxæ short, supracoaxal process attaining the mesosternum, side-pieces large, but so much inflexed as to be inconspicuous. Hind tarsi rather long, basal joint twice as long as the second, terminal joint inserted at the extremity of the third joint, the fourth joint being produced under the fifth.

The tarsal structure brings this genus near *Stilomedon*, from which it differs in many particulars, such as the form of the labrum and the denticulation of the mandibles, the sub-

globose joint of the maxillary palpus, and the very short prosternum.

Eomedon hirtellus, n. sp.

Brevis, crassiusculus, hirtellus, ferrugineus; elytris apicem versus testaceis, pedibus pallide flavis; prothorace fortiter transverso, elytris hoc paulo longioribus.

Long. $3\frac{1}{4}$ millim.

Antennae short and thick, thicker towards the extremity, penultimate joints strongly transverse. Head transversely quadrate, closely and very coarsely punctate. Thorax very short, nearly twice as broad as it is long, very densely coarsely punctate, with trace of a smooth line along the middle. Elytra short, ferruginous at base, yellow towards the extremity, sparingly punctate, strongly pubescent. Hind body strongly pubescent.

Nagasaki, in April and May, 1881.

STILICODERUS, nov. gen.

Labrum medio longitudinaliter carinulatum. Palpi maxillares articulo ultimo elongato, magno. Mandibula sinistra tri-, dextra quadridentata, dentibus magnis. Caput collo angustissimo. Tarsi posteriores articulis quatuor basalibus gradatim decrescen-
tibus, articulo basali quam articulo ultimo haud longiore.

This genus should be placed near *Trochoderus* and *Stilicus*. It differs from the latter by the structure of the labrum and mandibles and the much greater development of the terminal joint of the maxillary palpi, as well as by the less elongation of the first joint of the hind foot. The prosternum is without the concavity visible in all the *Stilici*, and the antennae are more of the filiform type. The genus in fact seems to be more closely connected with several genera that form a series of connecting-links between *Medon* and *Stilicus*. From *Trochoderus*, the genus of the group in question to which it is nearest, it departs by the very different structure of the labrum; this has two teeth in the middle, but it has also a longitudinal carina extending all along the upper surface of the labrum and projecting in front, so that the middle of the labrum is actually tridenticulate. The comparative proportions of the joints of the hind foot constitute another difference between the two genera.

Stilicoderus signatus, n. sp.

Niger; pedibus testaceis; antennis extrorsum rufis; elytris fortiter, parce, subseriatim punctatis, singulo humerum versus macula magna sanguinea.

Long. 7 millim.

Antennæ about as long as head and thorax, piceous at the base, rufescent at the extremity, third joint much longer than the second, tenth as long as broad. Head elongate, rather shining, black, rather deeply, closely, and moderately coarsely punctate, the interstices quite even, not in the least rugose, eyes rather small, convex in front. Thorax a little narrower than the elytra, slightly narrowed behind, attenuate in front, covered with a sculpture of elevated granules, with a broad, shining, smooth line along the middle. Elytra rather short, about as long as the thorax, feebly pubescent, shining, with numerous coarse punctures arranged irregularly in a serial manner, with a large but not very sharply limited mark near the base of each. Legs yellow, coxæ fuscous. Male with a large, broad, angular excision of the last ventral plate.

A small series of this species was found amongst moss at Ashinoyu, and two or three examples were captured at Miyanoshita. *Pederus Poweri* and *parallelus* were associated with it.

Stilicus longipennis, n. sp.

Angustior, nigricans; antennis, palpis pedibusque testaceis; capite thoraceque confertissime punctatis, opacis, hoc medio subtiliter canaliculato; elytris prothorace longioribus, ad latera rufosordidis, ad suturam fusciscentibus.

Long. $4\frac{1}{2}$ millim.

This is readily distinguished from the other Japanese species by the canaliculate prothorax and the longer elytra. The head is rather narrow, not at all transverse; the thorax elongate, longer than broad, the lateral angles quite indistinct, the median channel is fine and shining, thus contrasting with the rest of the thorax. The elytra are narrow, somewhat shining, excessively finely punctate, with a few indistinct larger punctures; they are of a fusciscent-red colour, darker towards the suture.

Nikko, Hakodate, Junsai; five specimens.

Group SUNIINA.

Mesunius optatus, n. sp.

Ferrugineus; antennis, palpis pedibusque testaceis; abdomine apicem versus fuscescendo; elytris thorace multo brevioribus. Long. 5 millim.

Antennæ with the first joint much longer and stouter than the others, reddish, the others yellow. Head much larger than the elytra, coarsely and closely punctate. Thorax distinctly longer than broad, much rounded in front, and a little narrowed behind, very coarsely punctate, somewhat shining, with a slight impression on either side of the middle at the base. Elytra small, narrow, especially at the shoulders, densely, coarsely, and deeply punctured. Hind body with the basal segments coarsely, the apical obsoletely, punctured. In the male the penultimate ventral segment is very deeply excised for the greater part of its length; each hind angle of the excision is furnished with a broad tuft of hairs, the tuft being acuminate and somewhat incurved. The terminal segment bears a very elongate narrow excision.

Sunius porosus, n. sp.

Minus gracilis, fortiter punctatus, opacus, niger; antennis, palpis elytrisque ferrugineis, pedibus pallide flavis. Long. $5\frac{1}{2}$ millim.

Antennæ moderately long, penultimate joint nearly twice as long as broad. Head broad, slightly broader than the elytra, coarsely reticulate. Thorax a little narrower than the elytra, much narrowed behind, slightly longer than broad, coarsely reticulate. Elytra only about as long as the thorax, very coarsely, deeply, and densely punctate. Hind body not very elongate, coarsely punctured; the two apical segments much more sparingly punctured and a little shining.

Yokohama; two females.

This is not very closely allied to any other; it may be placed between *S. histrio* and *S. filiformis*.

Sunius suffusus.

Sunius suffusus, Sharp, Trans. Ent. Soc. Lond. 1874, p. 73.

Mr. Lewis has now procured a good series of this species, showing that it is variable in colour; it may be either ferruginous, with the apex of the hind body black, or the body

with the exception of the elytra may be entirely black. Intermediate specimens occur in which the head, thorax, and hind body are of a ferruginous colour but more or less suffused with black.

Nagasaki, Yokohama, and Miyanoshita.

Stilicopsis setigera.

Acanthoglossa (?) *setigera*, Sharp, Trans. Ent. Soc. Lond. 1874, p. 67.

As *Acanthoglossa*, Kr., cannot at present be distinguished from *Stilicopsis*, I alter the name of this species in accordance with that view. The insect was met with sparingly about Yokohama and Nagasaki.

Group PÆDERINA.

Pæderus parallelus.

Pæderus parallelus, Weise, Deutsche ent. Zeitschr. xxi. p. 368.

Nikko and Chiuzenji in August, and Ashinoyu (abundant); Junsai (*Lewis*); Hakodate (*Weise*).

Subfam. PINOPHILINÆ.

Pinophilus punctatissimus, n. sp.

Elongatus, omnium densissime punctatus, dense subtilissime pubescens, ubique opacus, nigerrimus; palpis, antennis pedibusque rufis, illis fusciscentibus.
Long. 20 millim.

Antennæ elongate, more slender at the extremity than at the base, sordid red. Head quite dull, densely minutely sculptured, and with distant larger punctures. Thorax large, about as broad as the elytra, nearly square, being about as long as broad, finely and extremely densely punctured, quite dull. Elytra a fourth part longer than the thorax, very densely, subrugosely, and rather finely punctate, dull. Hind body densely punctate. Legs clear red.

This is allied to *P. javanus*, Er., but is readily distinguished by the absence of any shining space on the head; only two female examples were found, one at Iitoyoshi, May 8, 1881, the other at Ogura, July 18, 1881.

Pinophilus Lewisius.

Pinophilus Lewisius, Sharp, Trans. Ent. Soc. Lond. 1874, p. 77.

This is a mountain species and apparently very rare, but has been again met with on Mitzuyama in April and May.

Procirrus Lewisii, n. sp.

Rufous-brunneous, opacus, densissime punctatus; antennis, palpis pedibusque flavis; elytris prothorace brevioribus.
Long. 8 millim.

Antennæ short, first and second joints as long as the four following, terminal twice as long as penultimate. Head sub-elliptical, very densely punctured. Thorax oblong, much longer than broad, nearly straight at the sides and scarcely narrowed behind, very densely punctured. Elytra very densely punctured, distinctly shorter than the thorax. Hind body thick, very densely punctured, yellowish at the apex.

Similar to the Mediterranean *P. Lefebvrei*, but with the head more truncate behind, the thorax less slender, and the elytra much smaller; probably apterous.

Nagasaki, April 4th, 1881; a single female *.

Ædichirus Lewisius.

Ædichirus Lewisius, Sharp, Trans. Ent. Soc. Lond. 1874, p. 76.

This elegant insect was met with on several occasions about Nagasaki in the spring of 1881, and a colony was found at Miyanoshita in May 1880; single examples also were procured at Hitoyoshi and Kiga. The series thus secured consists of about thirty individuals and shows that the species is somewhat variable; the dark colour of the knees is specially an inconstant character and is not exhibited

* The following closely allied species is, I believe, the only nondescript *Procirrus* extant in collections:—

Procirrus fuscus, n. sp.

Fuscus, opacus, densissime punctatus; antennis, palpis pedibusque fusco-testaceis; elytris prothorace fere brevioribus.
Long. 8 millim.

Hab. Dacca, Ind. or.

This is very close to *P. Lefebvrei* and *P. Lewisii*, though distinguished from both by the darker colour, and in respect of the shape of the head, thorax, and elytra it is intermediate between the two.

at all in several of the Miyanoshita examples. The specimens procured about Nagasaki also vary a little in the length of the elytra. No individuals were found, however, to connect the species with *Æ. idæ*; but as that insect is distinguished only by the rather longer elytra being more closely punctate, especially at the base, it is quite possible it may prove to be connected with *Æ. Lewisius* by intermediate examples.

Subfam. *EVÆSTHETINÆ*.

Edaphus japonicus, n. sp.

Brevis, convexus, nitidus, parce pubescens, fere impunctatus, dilute piceus; antennis, palpis pedibusque testaceis; capite minute profunde biimpresso; prothorace basi quadriimpresso.

Long. $1\frac{1}{3}$ millim.

Head very small, scarcely half as broad as the elytra, the surface uneven, owing to two impressions between the eyes, so that there appears to be a tubercle on each side close to the eye; this latter organ is very convex. Thorax rather broader than long, very much narrower than the elytra, narrowed behind, with a transverse basal depression, limited at each hind angle by a fine carina and divided in the middle by a similar carina, each lateral portion also divided into two. Elytra longer than the thorax, with fine sutural striæ and feeble punctuation and pubescence. Hind body short, acuminate behind, the basal dorsal segment a good deal longer than the second.

Two examples; Nagasaki, end of March 1881, in hay refuse.

Subfam. *STENINÆ*.

Stenus biguttatus, var.

Stenus biguttatus, Er. Gen. et Spec. Staph. p. 690.

Awomori, Hakodate.

The Japanese examples differ from those of Europe and eastern Siberia in possessing a greater development of the male characters; the hind margin of the antepenultimate ventral ring is a little emarginate, the surface depressed and polished in front of the emargination; the hind margin of the preceding segment also is very feebly emarginate.

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Stenus alienus.

Stenus alienus, Sharp, Trans. Ent. Soc. Lond. 1874, p. 81.

This was found as far north as Hakodate and is apparently the most common of the Japanese *Steni*.

Stenus tenuipes.

Stenus tenuipes, Sharp, Trans. Ent. Soc. Lond. 1874, p. 80.

This was obtained as far north as Hakodate and Sapporo.

Stenus anthracinus, n. sp. (Sect. I. A^{**}, Erichson.)

Elongatus, angustulus, nigerrimus, subopacus, palporum basi testacea; capite excavato, vertice summo medio anguste carinato. Long. 5 millim.

This is allied only to *S. macies*, from which it is distinguished by the very black colour and the scarcely perceptible pubescence, the more rugose sculpture, the slender carina on the back of the head, and by the black legs. The basal joint of the palpi and the base of the next joint are yellow. The thorax is slender, rounded at the sides, very densely, rather finely, but quite rugosely punctured. Elytra a little longer than the thorax, densely rugose-punctate. Hind body obsoletely punctate, the segments without cusps. Legs slender and elongate, quite black.

Oyama, May; Kashiwagi, June: two female examples.

Stenus Lewisius.

Stenus Lewisius, Sharp, Trans. Ent. Soc. Lond. 1874, p. 82.

This has now been found in some numbers and as far north as Otaru, in Yezo.

Stenus lentus, n. sp. (Sect. I. A^{***}, Erichson.)

Robustus, sat nitidus, niger; palpis testaceis articulo ultimo fusciscente, pedibus rufis, geniculis fuscis; fortiter punctatus, haud rugosus; elytris thorace paulo longioribus. Long. 7 millim.

Antennæ with third to eighth joints piceous; palpi elongate, yellow, the terminal joint fusciscent, but not on its basal part. Head a little concave, broadly bisulcate, the grooves separated by a broad interstice. Thorax a little

longer than broad, coarsely, closely, and irregularly punctate, shining. Elytra coarsely punctate, but shining. Hind body sparingly and coarsely punctured, the segments at the base with a single cusp in the middle, the lateral margins distinct and raised.

Nikko ; three female examples.

This is not closely allied to any known species.

Stenus distans, n. sp. (Sect. I. A***, Erichson.)

Elongatus, opacus, niger, vix subnlescens ; palpis flavis, pedibus rufis, geniculis fusciscentibus ; fortiter rugoso-punctatus ; elytris thorace paulo brevioribus ; abdomine subtiliter marginato.

Long. $5\frac{1}{2}$ millim.

Antennæ rather short, the two basal joints black, the others piceous black. Palpi yellow. Head slightly concave, rather feebly sulcate, with a moderately broad, slightly elevated interstice ; very coarsely and densely punctured. Thorax much rounded at the sides, scarcely longer than broad, with a slight depression on the middle, very coarsely and densely punctured. Elytra narrow at the shoulders, very coarsely punctured. Hind body densely and coarsely punctured, the segments with a single carina on the middle of each at the base, and the basal two segments each also with a short lateral projection. Legs rather long and slender.

Nagasaki, April 4th ; two female specimens.

This is not closely allied to any other species ; the abdominal margins, though quite fine, are distinct.

Stenus laborator, n. sp. (Sect. I. B, Erichson.)

Elongatus, angustulus, niger, opacus, densissime punctatus ; palpis pallide flavis, pedibus testaceis, geniculis fusciscentibus ; elytris thorace paulo longioribus.

Long. 5 millim.

Head excavate, bisulcate, with very feebly elevated interstice. Thorax rounded at the sides and narrowed behind, longer than broad, extremely densely, rather finely punctured, slightly uneven. Elytra slightly longer than the thorax, the humeral angles rectangular, extremely densely punctured. Hind body slender, the basal segments distinctly punctate, the other quite obsoletely punctured, bearing a distinct, fine, depressed pubescence. The male has a minute acumen on the inner face of each of the anterior four tibiæ at the apex, and a rather more distinct tubercle on the hind

tibiæ a little distance above the apex; the femora are a little inflated and the apices of the hinder trochanters spinose; the breast is finely pubescent; the terminal ventral ring bears a deep narrow notch behind and in front is bicarinate, the preceding segment is depressed in the middle and acutely carinate on each side of the depression, and the antepenultimate is broadly but slightly depressed.

Yokohama, Osaka.

This species resembles those of the *S. speculator* group rather than the species amongst which it is placed on account of its immarginate hind body. It has no European ally.

Stenus hirtiventris, n. sp. (Sect. I. B, Erichson.)

Niger, sat nitidus, pube albida suberecta parce vestitus, fortiter punctatus, pedibus piceis; elytris thoracis longitudine.

Long. 3 millim.

Antennæ short and stout. Head not at all concave, the vertex elevated in the middle, very feebly depressed on each side. Thorax subglobose, very coarsely punctured. Elytra also coarsely punctured. Hind body convex, the basal segments distinctly, the apical sparingly and obsoletely punctured, the segments at the base tricuspidate. Legs rather short, basal joint of the palpi pale.

Niigata, 9th September, 1881; a single female.

This little insect has no close ally, but somewhat resembles the European *S. fuscipes* belonging to another section of the genus.

Stenus bicolon, n. sp. (Sect. II. A, Erichson.)

Elongatus, niger, sat nitidus; palpis, antennis pedibusque flavis; elytris singulo apicem versus macula parva aurantiaca.

Long. $5\frac{1}{2}$ –6 millim.

Antennæ very long and slender, the elongate club slightly infusate; palpi very long. Head broad, eyes widely separated, a slight broad depression on each side. Thorax longer than broad, a good deal rounded at the sides, very densely and deeply punctate. Elytra scarcely longer than the thorax, densely, deeply and rather coarsely punctured, each with an elongate, rather small, reddish spot, placed much nearer to the hind margin than to the base. Hind body closely punctate, the punctuation rather coarse at the base, much more obsolete at the apex, the segments entirely without cusps. Legs long, tarsal lobes rather long. The

male has a slight emargination on the hind margin of the last ventral plate and the following segment is finely bicarinate in front of the hind margin.

Oyayama and Miyanoshita in April and May.

This is the only species in this section that possesses spotted elytra.

Stenus palpalis, n. sp. (Sect. II. A, Erichson.)

Nigerrimus, nitidus, subcylindricus; antennis, palpis pedibusque rufo-testaceis, illarum clava fuscescente; fortiter rugoso-punctatus; elytris thoraceque longitudine æqualibus; abdomine obsolete marginato.

Long. 6 millim.

Palpi extremely long. Head very broad, broader than the elytra, not excavate, with two broad vague grooves. Thorax about as long as broad, rounded at the sides and much narrowed behind, coarsely, deeply, and very densely punctate. Elytra extremely coarsely punctate, very slightly narrowed at the shoulders. Hind body sparingly punctate, the punctures at the base very coarse, on the apical segment much less so. Tarsal lobes large. The male characters are slight, but there is in that sex a broad, rather shallow, angular notch on the last ventral plate.

Ichiuchi and Sendai; two specimens.

This is somewhat similar to *S. subcylindricus*, Scriba, but is much closer to an undescribed species from Amurland. It connects the species of this section with those of the following, being similar to *S. mysticus*; that species possesses traces of the lateral margin on each of the segments of the hind body in the form of a single raised line; but in *S. palpalis* there are two raised lines on each segment, so that the side-margin exists, though not raised or prominent.

Stenus latitarsis, n. sp. (Sect. II. A, Erichson.)

Robustus, niger, parce breviterque albido-pubescent; tarsis latis, articulis ultimis fuscis; antennis palpisque fusco-rufis, illis articulo basali nigro.

Long. 5 millim.

Antennæ rather short. Head not at all excavate, with slight convexity on the middle of the vertex and very slightly depressed on each side. Thorax longer than broad, rather closely punctate, with an indistinct, rather short, smooth space on the middle. Elytra a little longer than the thorax,

moderately coarsely and closely punctured. Hind body stout at the base, much narrowed to the extremity, punctuation rather distant and not coarse, the segments unicuspidate at the base in the middle, and the basal segment with a feeble lateral cusp. Legs rather short. The male characters are slight and consist of a feeble broad emargination of the last ventral plate and a slight deplanation of the preceding segment along its middle.

Miyanoshita; two examples.

Not very near any other species, but comes in the neighbourhood of *S. bifeveolatus*, Gyll.

Stenus insularis. (Sect. II. A, Erichson.)

Stenus insularis, Sahlb. Veg. exp. Vet. iv. p. 53.

"Hiro Sami."

This apparently has not been met with by Mr. Lewis.

Stenus mysticus, n. sp. (Sect. II. B, Erichson.)

Niger, subopacus, rugoso-punctatus; antennis, palpis pedibusque fusco-testaceis; clytris thorace paulo longioribus; abdomine haud omnino immarginato, tarsorum lobis occultis.
Long. 4 millim.

Palpi and antennae fuscous, the basal joint of the latter rather clearer yellow. Head broad, a little concave, with a broad, very slight interstice separating the indistinct ocular grooves. Thorax about as long as broad, densely rugose-punctate, longitudinally impressed on the middle, much rounded at the sides. Elytra coarsely and closely longitudinally rugose. Hind body rather slender, subcylindric, coarsely punctate, the segments ecuspidate. The male has a broad, only moderately deep, angular notch on the last ventral plate, and the preceding segment is broadly but very slightly depressed along the middle towards the extremity.

Nikko.

This species is liable to be overlooked, as its true position is not very clear; the tarsal lobes are short and can only be seen by a careful inspection, and the margins of the hind body are not quite absent; hence it might be looked for in section I. A*** of Erichson.

Stenus indubius, n. sp. (Sect. II. B, Erichson.)

Niger, parum nitidus, subcylindricus: antennis, palpis pedibusque

flavis, illis extrorsum fusciscentibus; fortiter denseque punctatus; elytris thorace brevioribus.

Long. 6 millim.

Antennæ and palpi very long. Head broader than the elytra, not concave, vertex broadly but vaguely grooved on each side. Thorax a little longer than broad, much rounded at the sides, densely and coarsely rugose-punctate. Elytra small, narrow at the shoulders, shorter than the thorax, coarsely and densely punctate. Hind body elongate, finely and sparingly, but quite distinctly pubescent, the basal segment coarsely, the apical quite obsoletely punctate. Tarsal lobes rather large. The male is distinguished by a very slight emargination on the hind margin of the last ventral plate.

Miyanoshita and Kiga; five examples.

This somewhat resembles *S. palpalis*, but is readily distinguished by the less coarse punctuation and by the absence of lateral margins on the hind body.

Stenus cephalotes, n. sp. (Sect. II. B, Erichson.)

Sat elongatus, niger, haud nitidus; antennarum basi, palpis pedibusque testaceis; elytris brevibus, thorace subgloboso brevioribus. Long. 3-3½ millim.

Antennæ and palpi only moderately long. Head very broad, with very large eyes, deeply depressed on each side, the interstice broad. Thorax about as long as broad, greatly rounded at the sides, very densely, rather coarsely punctured, rugose. Elytra very short, narrow at the shoulders, densely and coarsely punctured. Hind body almost without pubescence, the basal segments coarsely punctured, the apical almost impunctate. Tarsal lobes slender. The male is distinguished from the female by the terminal ventral plate being truncate instead of acuminate.

Nagasaki in March and April.

Though very different from *S. rufescens* in colour this is similar thereto in size and form.

Stenus confertus, n. sp. (Sect. II. B, Erichson.)

Niger, opacus, fortiter densissime punctatus, brevissime albido-pubescent; antennis, palpis pedibusque testaceis, geniculis antennarumque clava fuscis; elytris thorace longioribus.

Long. 3-3½ millim.

Palpi and antennæ short. Head broad, not concave,

without grooves. Thorax rather longer than broad. Elytra longer and much broader than the thorax, rather convex, coarsely and extremely densely punctured. Hind body elongate-conic, extremely densely punctured, the sculpture uniform, as coarse on the apical as on the basal segments. Legs yellowish, apex of femora and base of tibiæ fuscous. Male with a broad slight emargination of the last ventral plate and with the preceding segment deplanate along the middle.

Sanjo, 3rd September, 1881 ; two examples.

This is like *S. dissimilis*, but is quite distinct on account of the longer elytra and the denser punctuation.

Stenus dissimilis.

Stenus dissimilis, Sharp, Trans. Ent. Soc. Lond. 1874, p. 87.

Nagasaki in March and April ; rare.

Stenus concinnus, n. sp. (Sect. II. B, Erichson.)

Angustus, sat elongatus, niger, sat nitidus, parce brevissime albido-pubescent, crebre fortiter punctatus ; antennarum basi, palpis pedibusque testaceis, femorum apicibus, tarsis palporumque articulo ultimo fusciscentibus.

Long. $3\frac{1}{2}$ millim.

Antennæ rather short and slender, base clear yellow. Head flat, densely and evenly punctured. Thorax rather longer than broad, subcylindric, only slightly curved at the sides, very densely punctured. Elytra slender, longer than the thorax, densely punctured. Hind body slender, the basal segment densely and coarsely, the apical sparingly and finely punctate.

Niigata, 15th September, 1881 ; one example.

This is most like *S. confertus*, but is very easily distinguished by the shining surface ; it has a more cylindrical thorax and is, judging from one example, a more slender insect.

Stenus oblitus.

Stenus oblitus, Sharp, Trans. Ent. Soc. Lond. 1874, p. 87.

Found sparingly in September and October ; Honjo, Furukawa, Niigata.

The male characters in this species are very slight and consist merely of a slight emargination of the hind margin of the last ventral plate.

Stenus mercator, n. sp. (Sect. II. B, Erichson.)

Elongatus, niger, vix subviridescens, pube albida, micante, depressa vestitus; antennis, palpis pedibusque pallide flavis, femoribus posterioribus apice nigro.

Long. 6 millim.

Head not excavate, but broadly and rather deeply impressed on each side. Thorax elongate, subcylindric, though slightly curved at the sides, closely, moderately finely punctured. Elytra elongate, longer than the thorax, densely punctured. Hind body elongate, rather closely but indistinctly punctured. The male has a rather large deep notch on the hind margin of the last ventral plate.

Junsai, Niigata.

This is similar to our European *S. solutus*, though with numerous points of distinction. Mr. Lewis some years ago found at Kiu Kiang a specimen that may be a variety of this species.

Stenus sedatus, n. sp. (Sect. II. B, Erichson.)

Elongatus, angustulus, niger, pube albida evidenter vestitus: antennis, palpis pedibusque pallide flavis; dense fortiter punctatus, sat nitidus.

Long. 6 millim.

Head broad, not excavate, but rather deeply depressed on each side, the interstice broad, not punctate on the middle; eyes large, widely separated. Thorax elongate, slightly rounded on the sides, very coarsely punctate. Elytra about as long as the thorax, closely and coarsely punctate. Hind body rather coarsely punctate, even at the extremity.

Niigata, 6th September, 1881; one female.

This may be placed between *S. cicindela* and *S. currax*, from the latter of which it is distinguished by its conspicuous white pubescence, which is more erect than usual in the genus, especially on the hind body.

Stenus velox, n. sp. (Sect. II. B, Erichson.)

Elongatus, angustus, nigerrimus, parcissime pubescens, fortiter punctatus, sat nitidus; antennis, palpis pedibusque elongatis, pallide flavis.

Long. $5\frac{1}{2}$ millim.

Head excavate, with a slight, narrow, less punctate elevation in the middle. Thorax very long and narrow, subcylindric.

dric, very densely punctate. Elytra densely and coarsely punctate, along the suture shorter than the thorax, at the sides about as long as the thorax. Hind body slender, elongate and cylindric, almost destitute of pubescence, very coarsely punctate. Male with a rather deep notch on the hind margin of the terminal ventral plate, and with the preceding segment slightly depressed along the middle and pubescent on each side of the depression.

Nikko, Tokio, Fukushima ; six specimens.

This is allied to *S. currax* and *S. sedatus*, but can be readily distinguished from the latter by the more slender form, intense black colour, and by the almost complete absence of pubescence on the hind body. *S. currax* has a differently formed head, comparatively obsolete punctuation on the hind body, and a remarkably conspicuous white pubescence on the basal segments of that part.

Stenus flavidulus, n. sp. (Sect. II. B, Erichson.)

Elongatus, angustulus, rufo-testaceus ; capite inter oculos, pectore abdominisque apice nigris ; antennis, palpis pedibusque flavis. Long. 5-5½ millim.

Antennæ very long. Head black, red in front of the antennæ, not excavate but broadly and shallowly bisulcate, rather sparingly punctate. Thorax elongate, subcylindric, rather coarsely but not densely punctate. Elytra as long as the thorax and punctate like it. Hind body slender, elongate, very scantily pubescent, the basal segments sparingly punctate, the apical almost impunctate. Male with a large angular notch on the last ventral plate.

Honjo, in Tokio, under rushes with *Drypta fulveola*, an insect of somewhat similar colour ; in late autumn and early spring in plenty.

This species is very distinct on account of its colour. The only species I am acquainted with that are like it in this respect inhabit Ceylon.

[To be continued.]

XXXVIII.—*Notes on some Buthidæ, new and old.* By R. I. Pocock, of the British (Natural-History) Museum.

[Plate XV.]

THE conclusions set forth in this paper as to the validity of certain doubtful species of *Buthus* and the descriptions of the

new forms herein contained are based upon an examination of the large number of specimens of this genus which are contained in the collection of the British Museum.

On *Buthus Martensii*, Karsch.

Buthus Martensii, Karsch, Mitth. Münchn. ent. Ver. 1879, p. 112.

The conclusion of the diagnosis of this species is as follows:—"An forsitan masculum tantum *Buthi hottentottæ* (Fabr.), cum qua specie magnam similitudinem habet; sed in permultis multorum locorum hujus speciei exemplis a me visis nullum digiti mobilis palporum lobo illo exstructum est."

Possessing but one male specimen wherewith to test the constancy of this character, Dr. Karsch was left in doubt as to the validity of the species described. An examination, however, of the specimens of *Buthus* contained in the British Museum has shown that *B. Martensii* is distinct from *B. hottentotta* and that the two may be readily separated by the following features:—

Buthus Martensii (Karsch). (Pl. XV. figs. 1, 1 a, 2.)

♂.—Hand thicker; fingers shorter.

Movable finger furnished with a conspicuous lobe, which fits into a corresponding excavation in the immovable finger.

Hand wider than forearm.

Length of "hand-back" about two thirds the length of the movable finger.

Width of hand a little less than one half the length of the movable finger.

♀.—Hand thinner; fingers longer.

Movable finger without lobe; immovable finger without excavation.

Hand narrower than forearm.

Length of "hand-back" about half the length of the movable finger.

Width of hand a little less than one third the length of the movable finger.

The type of this species (a male) was from Singapore.

The British Museum possesses nineteen specimens:—India (two females), Sikkim (one male), Umballah (two females), Bengal (two females, two males), Madras (three males, three females); and in addition four specimens (one male, three females) without locality affixed.

Buthus hottentotta (Fabr.). (Pl. XV. fig. 1 b.)

♂ ♀.—Alike in the form of the hand.

Movable finger with a feeble lobe which fits into a correspondingly feeble excavation in the immovable finger.

Hand about as wide as the forearm.

Length of "hand-back" more than half but less than two thirds of the length of the movable finger.

Width of hand considerably less than one half the length of the movable finger.

Of this species the British Museum possesses one specimen from Gambia, two from Shongo, two from the Niger, and also four adults and a number of young in various stages of growth from West Africa.

It will be noticed from the foregoing paragraphs that the last-named species occurs in Africa, while the other is Oriental, and that the African species, alike in its sexes, is intermediate between the male and the female of the Oriental species.

It seems very probable from the fact that *B. hottentotta* is intermediate between the sexes of *B. Martensii* that these two species have been hitherto confounded in museums under the name "*hottentotta*."

This belief is based in part upon the circumstance that the Marquis G. Doria has lately kindly presented to the British Museum two specimens of a *Buthus* from Bengal which had been identified in the Genoa Museum as *B. hottentotta*, Fabr. In reality these specimens are males of *B. Martensii*.

It will be interesting to discover to what extent, if at all, specimens from intermediate localities serve to fill up the structural interval which separates the African and Asiatic forms, and to learn thereby how valid is the conclusion that the two are to be ranked as distinct species.

On *Buthus confucius*, Simon. (Pl. XV. fig. 2 a.)

Buthus confucius, Simon, Ann. Soc. Ent. Fr. (5) x, p. 124.

The validity of this species has been called in question by Dr. Karsch (Berl. ent. Zeitschr. xxv. p. 219) while reporting upon a collection of Arachnida from China. In this collection was a species of *Buthus* from Peking which was referred to "*B. Martensii* (Karsch) (=syn. *Buthus confucius*, E. Simon?)."

There are, however, several reasons which lead me to think that Dr. Karsch has fallen into error in this instance. In

the first place it does not seem likely that a mistake should be made in the identification of a specimen of *B. Martensii*; for Dr. Karsch has made comparatively easy the recognition of his species by giving, in addition to a detailed description, a comparison between it and a form so well known as *B. hottentotta*, Fabr.

In the second place, Mons. Simon has made perhaps but little less certain the identification of *B. confucius* by adding at the end of the description of this species the following words:—"Très-commun sur les rochers de l'île du phare de Tchefou; également commun à Pékin" &c.

Now the British Museum possesses no less than thirty-five specimens of a species of *Buthus* which were brought by Col. Swinhoe from Pekin and Tchefou; and these specimens agree with the description of *B. confucius* sufficiently well to leave no doubt but that they are rightly to be called by that name. Moreover, as stated above, the Museum possesses a long series of Scorpions which agree precisely with the diagnosis of *B. Martensii*. But a comparison between these last and those from Pekin and Tchefou settles at once the question as to the points of similarity and difference between the two series, and shows that the points of difference are amply sufficient to justify their separation as distinct species; for all the specimens of *confucius* may be recognized at a glance from all the specimens of *Martensii* by the form of the fifth caudal segment. This segment in *Martensii* is beneath remarkably convex from before backwards and from side to side, and the carinæ are evenly granular throughout; posteriorly this segment is not constricted, and there is no conspicuous dilatation of it on each side of the vesicle. But in *confucius* the under surface of the fifth caudal segment is but little convex, and its armature is rather denticulate than granulate; the denticles on the posterior half of the keels being larger than those on the anterior half. Moreover the inferior surface is distinctly constricted behind and dilated into a conspicuous lobe. In addition to these features the two species may be separated by others almost equally well-marked; for instance the dorsal abdominal keels in *confucius* are much more complete and parallel than they are in *Martensii*, and the female of *confucius* has a much thicker hand.

Buthus socotrensis, sp. n. (Pl. XV. fig. 3.)

Colour very characteristic. The whole body, above and below, with palpi, legs, tail, and cephalothorax uniformly ochraceous, testaceous, or a combination of the two; the

distal end of the chelicerae, the area of the lateral and median eyes, and of the anterior cephalothoracic keels black.

The species bears considerable resemblance to *B. hottentotta* and *B. Martensii*, and undoubtedly appertains to that section of the genus of which *hottentotta* may be regarded as the type.

Cephalothorax.—Much the same shape as in *hottentotta*, but the median eyes are larger and considerably more widely separated; anterior keels not smooth between the eyes, diverging normally in front and joining each other in the middle line on the front edge of the cephalothorax; the area between them almost smooth. The posterior keels almost parallel, joining and being in almost the same straight line with the internal median keels, which are consequently themselves nearly parallel, the two on each side constituting only a slightly sinuous line; the external median keel not prominent and not united by a transverse line of tubercles with the anterior end of the posterior keel as it is in *B. europæus*. The rest of the cephalothorax sparsely granular.

Tergites.—The first six marked with three keels, although the lateral keels of the first may be represented by a single large granule only; these keels granular and becoming progressively more expressed from before backwards; the lateral diverging in front; but none of the keels are conspicuous on account of their being of the same colour as the rest of the segment; keels of the seventh segment like those of, *e. g.*, *B. hottentotta*.

Sternites as in *B. hottentotta*, except that the four keels of the fifth are of the same colour as the rest of the segment.

Tail.—Slightly narrowed from base to apex, considerably more shallowly excavated above than in *B. hottentotta*, *B. Martensii*, and *B. judaicus*; upper surface of the fifth segment with a shallow depression in its posterior half. The first four segments provided each with ten keels, for the most part feebly granular; the inferior keels, almost smooth in front, become more granular behind; the superior keels, on the other hand, become less granular behind; the inferior intercarinal spaces smooth behind and becoming more granular in front; the superior intercarinal spaces sparsely granular behind, more thickly so in front; on the fourth segment the granules of the upper surface are arranged in a definite longitudinal series, and constitute a distinct keel; consequently this segment, having a complete though feeble median lateral keel, is supplied with *twelve* keels. Fifth segment much like that of *B. hottentotta*, but less narrowed behind and less excavated above; superior keels absent, the segment being merely

granular above at the sides; inferior and lateral keels evenly granular throughout and nowhere denticulate; the granules of the inferior intercarinal spaces are arranged on each side in a definite series, thus constituting a keel, so that when viewed from below this segment appears to be furnished with five keels.

Vesicle large, dilated, its height being as great as or greater than its width and as great as or a little greater than the width of the anterior end of the fifth caudal segment; granular beneath; aculeus sharply curved backwards, considerably or a little shorter than the vesicle; together the two are about as long as the fifth caudal segment.

Palp.—Humerus almost as in *B. hottentotta*, except that the granules are finer; brachium not costate behind; superior keels very finely granular; anterior keels more coarsely granular. Manus not costate; a little narrower than the brachium and shorter than the dactyli; dactyli long, slender, incurved; the movable dactylus in one specimen about twice the length of the "hand-back," in the others considerably less so; the movable dactylus furnished with a small basal lobe. External surface of femora of legs granular.

Pectines (exclusive of the teeth) shorter than the cephalothorax; number of teeth 24–25 (♀?), in one specimen 28–29 (♂?).

All the appendages are hairy, mostly sparsely so, but on the manus and dactyli the hairs are very short and close-set; the anterior margin of the cephalothorax is furnished with a row of hairs, and on the under surface of the tail the hairs are few but symmetrically arranged.

Measurements in millimetres of largest specimen.—Total length 76, of tail 44, of cephalothorax 9; width 10; first tail-segment, length $5\frac{1}{2}$, width $5\frac{1}{2}$, height $4\frac{3}{4}$; fifth tail-segment, length $9\frac{1}{4}$, width $4\frac{3}{4}$, height $4\frac{1}{2}$; vesicle, length $6\frac{1}{4}$, width $4\frac{1}{4}$, height $4\frac{1}{2}$; palp, length of humerus 7, of brachium $8\frac{3}{4}$, width of latter 4; width of hand $3\frac{3}{4}$; length of "hand-back" $5\frac{3}{4}$, of movable finger $10\frac{1}{2}$; length of pecten $7\frac{3}{4}$.

Four specimens collected in the Island of Socotra by Prof. Baillie Balfour.

I am doubtful as to the sex of these specimens; possibly the one presenting twenty-eight pectinal teeth is a male; if so this variation in the number of pectinal teeth is the only noticeable character by which the sexes may be separated.

In the length of the fingers and slenderness of the hand this species somewhat calls to mind the female of *B. Martensii*; but the movable dactylus is furnished with a much

more conspicuous basal lobe than in the female of that species. It differs from both *B. hottentotta* and *B. Martensii* in its larger and more widely separated median eyes, in its more widely separated and more parallel posterior cephalothoracic carinae, in its larger vesicle, and, above all, by the additional twelfth row of granules on the superior surface of the fourth caudal segment; this last is in fact a characteristic by which it may be separated from, I believe, all the species of *Buthus* that have been hitherto described, although it is at the same time a characteristic which is faintly foreshadowed in the reduplication of the series of granules which constitute the superior keels of the fourth and fifth caudal segments in some of the species allied to *B. liosoma*.

Buthus atlantis, sp. n. (Pl. XV. fig. 4.)

Cephalothorax almost exactly like that of *B. europæus*, except that the anterior granular keels are set a little nearer together; as in that species, the posterior keels are widely separated, very slightly converging, separated anteriorly by a smooth space from the internal median keel, but united by a conspicuous transverse row of tubercles with the well-expressed external median keel; and, further, between the posterior keel and the external margin of the cephalothorax there is an additional short series of granules corresponding in position with the fifth tergal keel of *B. quinque-striatus*.

Tergites as in *B. europæus*, each, except the first two, in which the lateral keels are obsolete, marked with three granular keels.

Sternites as in *B. europæus*.

Tail very different from that of the last-named species, long, slender, very shallowly excavated above. The first segment with ten well-expressed granular keels; the median inferior keels converging behind; the second segment with eight complete keels, the supernumerary median lateral keel being merely represented in the posterior half of the segment; the median inferior keels converging behind; third segment resembling the second, except that the supernumerary keel is still less developed, being represented merely by a few granules; in the fourth segment this keel is absent. The superior keels of these four segments are finely granular; the inferior keels more coarsely so than the superior, and becoming progressively more strongly expressed from behind forwards; the median inferior keels of the second and third segments are not denticulated as in *B. europæus*; all the intercarinal spaces are very finely granular. Fifth segment with very

shallow median depression above, a little depressed towards its hinder end, and a little constricted at the sides; dilated beyond the constriction into a tridentate lobe; inferior lateral keels becoming gradually more strongly dentate from behind forwards. Vesicle about the same form in proportion to the tail as in *B. europæus*, i. e. it is less globular; aculeus longer than in *B. europæus*.

Palp very like that of *B. europæus*; fingers very slightly incurved, nearly straight, the movable without a basal lobe the immovable without an excavation.

Coxæ and *legs* hairy and granular, as in *B. europæus*.

Pectines with 25–26 teeth.

Measurements in millimetres.—Total length 89; length of cephalothorax $9\frac{1}{2}$, width 11; length of tail 56; first caudal segment, length 7, width 6, height $5\frac{1}{2}$; fifth caudal segment, length 11, width $4\frac{1}{4}$, height 4; length of vesicle 6, width $4\frac{1}{4}$, height 4; aculeus $5\frac{1}{4}$; length of humerus $7\frac{3}{4}$, of brachium $9\frac{1}{4}$, of "hand-back" $6\frac{1}{2}$, of hand 8, of movable finger $10\frac{1}{2}$; width of hand 4, of brachium 4.

A single specimen (sex unknown) from Mogador, collected and presented to the British Museum by Mr. C. A. Payton.

It is by the form of the tail alone that this species may be recognized from the well-known *B. europæus* (Linn.). This organ is much longer than in the latter species, being nearly six times as long as the cephalothorax; the inferior keels of the second and third segments are uniformly granular, the inferior lateral keels of the fifth become gradually dentate from before backwards, and the posterior lateral lobe of this segment is tridentate: the vesicle too is less globular, the aculeus longer and less curved.

Buthus Phillipsii, sp. n. (Pl. XV. fig. 6.)

Colour very variable; appendages and tail ochraceous or testaceous; hand of palp darker, with obscure paler longitudinal bands; tergites paler behind, darker in front; cephalothorax fuscous to testaceous. Eyes, anterior and posterior keels of the cephalothorax, keels of the tergites, and those of the hinder end of the under surface of the tail may be black or almost the colour of the rest of the plates, and there may be an additional black patch at the sides of the cephalothorax and of the tergites.

Cephalothorax finely granular all over except between the median eyes; granules between the anterior and posterior

keels smaller than upon the sides of the cephalothorax ; anterior keels granular, generally falling short of the anterior margin, rarely attaining it ; anterior margin bearing a series of granules and a few scattered hairs. Posterior keels converging in front and meeting the hinder extremities of the internal median keels, the two constituting a sinuous series of granules ; more rarely the extremities of these two keels fail to meet ; external median keel sometimes connected with the posterior keel by a more or less definite series of granules, but more commonly the granules in this part are neither larger nor more definitely arranged than upon the rest of the cephalothorax ; median eyes considerably in front of the middle of the cephalothorax.

Tergites sparsely but somewhat coarsely granular at the sides, smoother, but feebly granular above, each marked with the three ordinary keels, which are much abbreviated in front.

Tail large ; first four segments nearly parallel-sided, the fifth much narrowed at its hinder end ; the first four deeply excavated above ; the superior keels very conspicuous, being rather denticulate than granulate ; the inferior keels, nearly smooth on the first, become gradually more coarsely granulate from before backwards ; the median lateral keel, complete on the first segment, present on the hinder half of the second, represented by two or three granules in the third, absent on the fourth ; the intercarinal spaces are almost wholly smooth ; fifth segment above with a very shallow median excavation in front, but depressed behind, scarcely at all constricted at the sides, the posterior extremity of the side denticulate and continuous, or nearly so, with the denticles of the inferior lateral keels ; these denticles, like those of the median keel, almost alike throughout the extent of the keel ; in some cases, however, they vary slightly in size ; the median keel breaks up behind into a few lateral granules ; inferior intercarinal spaces furnished with a few more or less serially arranged large granules or tubercles ; all the segments of the tail are more or less hairy above and below, the hairs being long, widely separated, but arranged in definite longitudinal series.

Vesicle feebly granular beneath, and hairy, a little wider than the posterior end of the fifth segment of the tail, but narrower than its anterior end ; aculeus shorter than the vesicle, both together shorter than the fifth caudal segment.

Palp beset with longish separated hairs ; humerus and brachium with the ordinary granular keels ; hand obscurely costate, as in *B. europaeus*, considerably wider than the brachium in male, as wide or wider in female ; dactyli short,

more incurved than in *B. europæus*; the movable dactylus in the male furnished with a large lobe, the immovable dactylus also with a large lobe, behind which is an excavation for the lobe of the movable dactylus; in the female there is a small but conspicuous lobe on the movable dactylus and a corresponding excavation on the immovable dactylus, but these two structures are much less well developed than in the male.

Legs and coxæ hairy and granular.

Pectines in male much larger than in female, being supplied with from 27–30 teeth and longer (without teeth) than the cephalothorax; in the female they have from 23–26 teeth and are shorter than the cephalothorax.

Measurements in millimetres of average-sized male.—Total length $47\frac{1}{2}$; length of cephalothorax $5\frac{1}{2}$, width $6\frac{1}{4}$; length of tail 32; first caudal segment, length $4\frac{1}{4}$, width $4\frac{1}{2}$, height 4; fifth caudal segment, length 7, width $3\frac{1}{2}$, height $3\frac{1}{4}$; vesicle, length $3\frac{1}{2}$, width $2\frac{3}{4}$, height $2\frac{1}{2}$; aculeus $2\frac{1}{2}$; length of humerus 5, of brachium $5\frac{1}{2}$, of "hand-back" $4\frac{1}{2}$, of hand 5, of movable digit $5\frac{1}{2}$; width of hand $3\frac{1}{2}$, of brachium $2\frac{1}{2}$; length of pecten $6\frac{1}{2}$.

A number of specimens of this species from Bushire were collected and presented to the British Museum by Mr. E. Lort Phillips.

Although this species bears a general resemblance to several others, it does not appear to present particular affinities with any one yet made known. The large size of the tail, together with the prominence and almost denticulate armature of its keels, not to mention the long hairs which adorn it, are perhaps the most noticeable of its features. In the form of these keels may be seen an approximation to the high compressed keels which characterize those Buthidæ belonging to the so-called genus *Androctonus*.

On *Buthus villosus*, Peters.

Buthus villosus, Peters, Monatsb. d. k. Preuss. Ak. Wiss. Berl. 1862, p. 26 Thorell, Etudes Scorpiol. p. 27.

Upon the occasion of drawing up a report upon a collection of Arachnida from Yemen, Mons. E. Simon (Ann. Mus. Genov. xviii. p. 244) sets down *B. villosus* (Peters) amongst the list of synonyms appertaining to *B. liosoma* of Ehrenberg; but scarcely rightly I think. For, in addition to some Arabian and several East-African specimens of a species of Scorpion which are undoubtedly referable to *B. liosoma*,

Ehrenb., the British Museum possesses others from Benguela and the Congo which are recognizable at a glance from *B. liosoma* and at the same time agree precisely with the elaborate description of *B. villosus* set forth by Dr. Thorell.

Perhaps the most noticeable points of difference are to be found in the form of the tail. This organ in *B. villosus*, instead of being dilated from the first to the fourth segment, as in *B. liosoma*, is distinctly wider at the base, the fourth segment being considerably narrower than the first. Moreover, while in *B. villosus* the first caudal segment is above more flat than it is in *B. liosoma*, the third, fourth, and fifth segments in the former are more deeply excavated than in the latter; the superior keels, too, are more dentate, particularly on the fifth segment; the vesicle and aculeus are larger. The colour of the body and limbs is much darker, the granules coarser, and, above all, the yellow hairs which are so conspicuous on various parts of the body, and particularly upon the tail, in *B. villosus* are only developed in *B. liosoma* to a relatively small extent.

In fact the characters of the two are sufficiently well marked to allow us to regard them as of specific importance.

Buthus planicauda, sp. n. (Pl. XV. fig. 5.)

Colour testaceous, ochraceous, or ochraceo-rufous; palpi and legs paler than trunk; the last three segments of the tail may be slightly deeper in colour than the rest.

Female.—*Cephalothorax* wider behind than it is long, much narrowed in front; anterior width about half its posterior width; marked with a median longitudinal depression, which is deeper behind, but shallower and gradually widened in front; entirely covered with close-set granules and marked with shallow lateral depressions; without a trace of keels. Ocular tubercle lightly hollowed, granular in the middle, smooth at the sides, situated in front of the middle of the cephalothorax.

Tergites finely granular, granules coarser upon the posterior half; each of the first six marked with a median keel; the last furnished with four anteriorly abbreviated granular keels, its upper surface shagreened.

Sternites almost wholly smooth; the first very slightly shagreened beneath the pectines on its extreme antero-lateral border; the last finely and sparsely granular at the sides and furnished with four slightly roughened keels.

Tail almost parallel-sided, the first and the fourth segments being equal in width; the first segment flat above

and shagreened, the second almost flat above, only very slightly depressed posteriorly, less shagreened than the first and more granular, bluntly keeled, the granules forming two parallel series at the sides of the upper surface; the third, fourth, and fifth conspicuously depressed, the third less than the fourth but more shagreened, the fourth less than the fifth but slightly shagreened and granular, the fifth being not shagreened. The first four marked with ten keels composed of rounded granules; the intercarinal spaces thickly granular; the inferior surface of the first segment less granular than that of the others; the granules of the keels are uniform in size; the superior keels of the fourth not consisting of two series of granules. The lower surface of the fifth segment thickly granular, with the median keel more or less strongly developed; the inferior lateral keels becoming bluntly dentate behind; this segment almost as elevated as the preceding.

Vesicle narrower than the fifth segment, covered beneath with larger and smaller blunt granules, and hairy; upper surface smooth, punctured; aculeus strong and gently curved; vesicle and aculeus together as long as or a little longer than the fifth caudal segment.

Palp.—Superior and anterior surfaces of humerus covered with fine granules and bounded by a row of larger granules; anterior surface, in addition, furnished with two irregular series of larger granules; inferior surface also finely granular; brachium very finely granular, not costate, with larger granules in front; manus slender, a little thinner than brachium; length of "hand-back" a little less than half the length of the movable finger; fingers long, incurved, without lobe or excavation. External surface of legs granular; the granules on the upper edges being arranged in longitudinal series. Coxæ quite smooth.

Pectines about as long as cephalothorax, furnished with 30–32 teeth; basal portion produced into a prominent lobe.

Male.—Manus round and thick, considerably thicker than brachium; "hand-back" a little more than two thirds the length of the movable finger; length of hand about equal to the length of the immovable finger; fingers not sinuous, but not in contact at the base when closed. Pectines longer than cephalothorax, with 35–38 teeth.

Measurements in millimetres of largest (♀) specimen.—Total length 78; length of cephalothorax $9\frac{1}{4}$, width $10\frac{1}{4}$; length of tail $49\frac{1}{4}$; first caudal segment, length $6\frac{1}{2}$, width 7; height 6; fifth caudal segment, length $6\frac{1}{4}$, width 6, height 5; vesicle, length 6, width 5, height 4; aculeus $5\frac{1}{2}$; length of

humerus 7, of brachium $7\frac{1}{2}$, of "hand-back" $3\frac{3}{4}$, of movable finger $8\frac{3}{4}$; width of hand 3, of brachium $3\frac{1}{4}$; length of pecten $9\frac{1}{4}$.

Five specimens:—two males from West Africa; three females, two from South Africa collected by Dr. Quain and Dr. Smith, and one, without locality, presented by Capt. Belcher, R.N.

This species is closely allied to *B. liosoma*, Ehr., and to *B. raudus* (Simon, Ann. Soc. Ent. Fr. (6) vii. p. 377), but differs from both in the flatness of the upper surface of the first two caudal segments and in the straightness of the keels which laterally bound this surface in the second segment; in *B. liosoma* these keels sensibly converge behind. Furthermore, the posterior segments are considerably higher and more deeply excavated than in *liosoma*, and the granules of the intercarinal spaces are smaller, more numerous, and more close-set.

Buthus limbatus, sp. n. (Pl. XV. figs. 7, 7a.)

Colour.—Middle of each tergite occupied by a wide black band; lateral portions testaceous or ochraceous; the extreme lateral border black; anterior portion of the cephalothorax from the median eyes to the lateral eyes black; posterior half above fuscous, at the sides ochraceous or testaceous; extreme lateral margin black. Upper and side surfaces of anterior four caudal segments ochraceous, of the fifth segment fuscous; under surface of fifth deep black, of the first four ochraceous, with four black keels; vesicle ochraceous, with a median dark line beneath, fuscous above and at the sides. Palpi, chelicerae, and legs ochraceous or testaceous; sternites and pectines testaceous.

Cephalothorax.—Anterior border slightly concave, narrowed in front, wider behind than long. Resembles that of *B. liosoma*, Ehr., in being without a trace of granular keels. The greater part covered with fine close-set granules; interocular area with a smooth median sulcus which can be traced in front and behind nearly to the anterior and posterior margins of the cephalothorax; in the posterior half from this smooth median tract proceed obscurely marked, smooth, transverse tracts, which extend over the lateral portions of the cephalothorax.

Abdomen.—First six tergites marked with but one median smooth keel in the hinder half; the rest of each very finely granular, with a coarser row on the hinder margin. Seventh

tergite marked in front with a low median keel and with two lateral, posteriorly converging, granular keels, which are not united in front by a transverse row of granules; intercarinal spaces finely granular.

Anterior four *sternites* perfectly smooth and marked in front with two obscure abbreviated sulci; the fifth bearing posteriorly four smooth keels, of which the two median are black.

Tail closely resembling in form that of *B. hottentotta*, Fabr., slightly attenuated towards the apex; the segments becoming progressively more hollowed from before backwards, the last being excavated behind almost as in *B. juluicus*, Simon. The first marked with ten complete keels, which, on the under surface, are much less sharply granular than on the upper surface; inferior intercarinal spaces smooth, superior very finely granular; second segment like the first, except that the median lateral keel is abbreviated in front; third segment smoother above than the first, with the inferior and lateral intercarinal spaces granular and the median lateral keel represented merely by an obscure line of fine granules; fourth segment smooth in the middle above, granular at the sides and beneath, entirely without, or at most with but the smallest indication of the median lateral keel; fifth segment not keeled above, merely granular; sides and under surface thickly covered with coarse granules; the inferior median keel more prominent than the inferior lateral keels; the blunt granules which mark the lateral keels becoming slightly larger towards the hinder end of the segment; the hinder end of the segment slightly constricted, then dilated into a feebly dentate lobe. Vesicle large, coarsely granular beneath, more finely at the sides, wider than the hinder end of the fifth segment, but narrower than its front end; a little thicker than it is high; longer than the aculeus, which is normally curved; vesicle and aculeus together a little longer than the fifth segment.

Appendages.—*Palp* (♀). Upper surface of humerus almost entirely smooth; bounded in front and behind by a conspicuous row of granules; anterior surface sparsely beset with small tubercles and bounded below by a row of granules; inferior surface smooth, posterior surface slightly roughened above; *brachium* not costate, sparsely granular in front; *manus* without keels or granules, punctured, shortly hairy, considerably thicker than the brachium; width of hand less than the length of the "hand-back"; length of "hand-back" less than the length of either finger; length of hand either equal to or a little less than the length of the immovable

dactylus; movable dactylus either a little longer than or equal in length to the brachium.

In the male the manus is thicker and the dactyli slightly shorter. External and inferior surfaces of the femora granular; coxæ perfectly smooth.

Pectines very large, without the teeth longer than the cephalothorax; projecting considerably beyond the edge of the posterior coxæ; furnished with twenty-six or twenty-seven long teeth, which are alike from base to apex in the male; but in the female the basal tooth is very much enlarged, being about twice as long as the rest and flask-shaped, *i. e.* dilated proximally and abruptly narrowed and slender distally.

Measurements in millimetres of largest specimen.—♀. Total length 58; length of cephalothorax $5\frac{1}{2}$, width $6\frac{1}{2}$; length of tail 31; length of first caudal segment 4, width 4, height $3\frac{1}{4}$; length of fifth caudal segment 6, width $3\frac{1}{2}$, height $3\frac{1}{4}$; length of vesicle $4\frac{1}{4}$, width 3, height $2\frac{3}{4}$; length of aculeus 4; length of humerus $4\frac{1}{4}$, of brachium $5\frac{1}{4}$, of "hand-back" $3\frac{7}{8}$, of movable dactylus $5\frac{1}{2}$; width of hand 3, of brachium $2\frac{1}{4}$; length of pecten (not including teeth) 6.

♂. Total length $45\frac{1}{2}$; length of cephalothorax 5, of tail $27\frac{1}{2}$, of pecten $5\frac{1}{2}$; width of hand 3, of brachium 2.

The male differs from the female in having the immovable finger excavated for the reception of a lobe on the movable finger, in having a thicker hand, and the pectinal teeth all alike.

Four specimens (three females, one male) from Madagascar, collected by the Rev. R. Baron.

In the absence of the cephalothoracic and of the lateral tergal keels this species resembles those belonging to the *B. liosoma* group. But in the form of the tail, which is slender and not strongly keeled, it is a *Buthus* sensu stricto. In fact between the two groups typified respectively by *B. europæus* and *B. liosoma* it constitutes one of the many structural links which show that for the latter group the generic name *Prionurus* cannot justifiably be retained. In addition to the interest attached to this species in this particular there is another feature which calls for special mention. This is the dissimilarity in size and shape existing in the female between the basal tooth of the pectines and those of the rest of the series. In this respect resemblance may be observed to the genus *Grosphus* of Simon (Ann. Soc. Ent. Fr. (5) x. p. 378)—a genus established partly on the strength of a similar

variation for the reception of *Androctonus madagascariensis* of Gervais (Arch. Mus. iv. p. 213, pl. xi. figs. 1-3).

The sexual nature of this variation in the pectinal teeth in the last-named species was to be inferred from the circumstance that the sexes of *Lepreus Fischeri* are to be distinguished by a similar variation, as pointed out by Dr. Karsch (Berl. ent. Zeitschr. xxx. p. 77); but the discovery of this new form, inhabiting as it does the same geographical area as *Grosphus*, and, moreover, closely allied to it, makes almost certain what could only be regarded as more or less probable before, and consequently serves considerably to weaken the basis upon which *Grosphus* was founded.

There is yet a third fact of special interest connected with this same Scorpion. In some species belonging to the *B. liosoma* group, to which, as above pointed out, *B. limbatus* appears to be allied, there is also in the female a variation in the structure of the pectines. But this, instead of being a difference in the appearance of the teeth, takes the form of a lobate dilatation of the base of the shaft which bears the teeth; and this dilatation in, e. g., *B. villosus* occupies the same position as does the dilated basal tooth of *B. limbatus*; so that clearly the same result has been attained in these two species by the modification of different structures, and therefore presumably independently in the two. The usefulness of some such modification could scarcely be more clearly demonstrated; but of its function I believe nothing is certainly known.

Buthus piceus, sp. n. (Pl. XV. figs. 8, 8a.)

Colour.—Dull black above, piceous, shining beneath; appendages and tail slightly paler than the trunk; pectines and distal tarsal segments of legs ochraceous.

Cephalothorax not furnished with keels, covered thickly with granules, not markedly attenuate in front; anterior border slightly concave; ocular tubercle situated well in the anterior half, with a shallow median sulcus; the portion of the cephalothorax which is in front of the tubercle is furnished with a very shallow median depression, but the portion behind the tubercle is deeply sulcate, the ordinary median sulcus being very strongly pronounced and giving off on each side about halfway between the ocular tubercle and the posterior margin a transverse sulcus, which, widening and deepening, extends to the lateral margin of the cephalothorax.

Tergites finely and closely granular; granules slightly larger in the hinder half of each; not furnished with three

keels; the first is simple, the second shows faint indications of a posterior median granular keel and of a shallow depression on each side in front of it, features which become gradually more conspicuous until the sixth somite is reached; seventh tergite with a conspicuous depression above in its posterior half, the median keel nearly obsolete, the lateral keels well shown and normal.

Sternites shining, smooth, the side margins only showing faint signs of granulation; the last with the four series of granules very poorly developed. *Stigmata* small, short, almost ovate; the sternal area surrounding them manifestly depressed.

Tail somewhat deeply excavated above, slightly attenuated; the first and second segments furnished with ten keels, the third and fourth with eight; keels very strongly granulate, almost denticulate; the superior keels on the second, third, and fourth segments ending behind in a larger tooth; superior intercarinal space nearly smooth; the other intercarinal spaces more or less thickly covered with fine granules; the fifth segment not lobate posteriorly, with keels evenly granulate throughout, closely resembling in fact that of, e. g., *B. hottentotta*.

Vesicle large, smooth above, coarsely, sparsely, serially tubercular beneath; the terminal tubercle beneath the aculeus is much larger than the others. Aculeus shorter than the vesicle and gradually and gently curved.

Palp.—Upper surface of humerus, except for the granular keels which bound it in front and behind, nearly smooth; anterior surface furnished with some smaller and a few larger granules; brachium obsoletely keeled above, but not granular, sparsely but conspicuously dentate in front; hand quite smooth, a little wider than the brachium, about as long as the immovable finger; length of "hand-back" about one third shorter than the length of the movable finger, but considerably greater than the width of the hand. Legs supplied with the usual series of granules; coxæ quite smooth.

Pectines short, about two thirds the length of the cephalothorax, furnished with 17–18 sharp teeth, which do not overlap each other; the basal tooth of the series very large indeed, widened, lobate, with rounded margin, as in *Grosphus madagascariensis*, and not distally narrowed and dentiform, as in *B. limbatus*.

Measurements in millimetres.—Total length 62; length of cephalothorax $6\frac{1}{2}$, width $7\frac{1}{4}$; length of tail 36, of first two segments 9; width of first caudal segment $4\frac{1}{4}$, of fifth $3\frac{3}{4}$, length of fifth 7, of vesicle 5, of aculeus 3; width and height

of vesicle $3\frac{1}{2}$; length of humerus $5\frac{1}{4}$, of brachium $6\frac{3}{4}$; width of brachium and of hand 3; length of "hand-back" 5, of movable finger $6\frac{3}{4}$, of pecten $4\frac{1}{2}$.

Two female specimens from Madagascar, presented to the British Museum by Mr. Lewis H. Ransome.

In the shape of the pulmonary stigmata this species stands by itself in the family Buthidæ, and should in consequence perhaps constitute a new genus. But it does not seem to me advisable to attach generic importance to this character, since the form of the apertures in question is not quite constant in *Buthus* and the specimens presenting the peculiarity are in the rest of their features so essentially referable to that genus. The dilated basal tooth of the pectines appears to indicate affinity between this new form and *B. limbatus* and *G. madagascariensis*. But, apart from the stigmata, *B. piceus* may be separated from the latter by the dentition of the chelicerae, from the former by its dark colour and by the simple shape of the before-mentioned pectinal tooth.

EXPLANATION OF PLATE XV.

- Fig. 1.* Hand of *B. Martensii* (Karsch), ♂.
Fig. 1 a. Ditto, ditto, ♀.
Fig. 1 b. Hand of *B. hottentotta* (Fabr.), ♀.
Fig. 2. Fifth caudal segment and vesicle of *B. Martensii* (Karsch).
Fig. 2 a. Ditto, ditto, of *B. confucius* (Simon).
Fig. 3. *Buthus socotrensis*, sp. n., nat. size.
Fig. 4. *Buthus atlantis*, sp. n., nat. size.
Fig. 5. Anterior two caudal segments of *B. planicauda*, sp. n.
Fig. 5 a. Ditto, ditto, of *B. liosoma* (Ehrenb.).
Fig. 6. *Buthus Phillipsii*, sp. n., nat. size, ♂.
Fig. 7. *Buthus limbatus*, sp. n., nat. size, ♀.
Fig. 7 a. The same. Basal portion of pecten.
Fig. 8. *Buthus piceus*, sp. n. Basal portion of pecten.
Fig. 8 a. The same. Second abdominal sternite with stigmata.

XXXIX.—*Descriptions of new Species of Rhopalocera from Mexico and Central America.* By F. D. GODMAN and O. SALVIN.

COLLECTIONS of *Rhopalocera* recently received by us from Mexico and other parts of Central America, as well as some submitted to us by Doctor Staudinger, contain representatives of the following species, which we believe to be undescribed.

As it will be some time before we can include them in our work on this region, we think it desirable to take an earlier opportunity of making them known.

1. *Pteronymia timagenes*, sp. n.

P. tigrani, nob., proxima, sed alarum marginibus multo rufescentioribus, anticarum margine interno medialiter tantum nigricante, macula cretacea ultra cellulam multo minore.

Hab. Mexico, Sierra Madre del Sur, alt. 6000–8000 feet (*H. H. Smith*).

Mr. Smith captured several specimens of this species at Omilteme and other places in the Sierra Madre del Sur. It is evidently a Western Mexican form of *P. tigranes*, and, like so many of the *Ithomiinæ* of this region, has the margins of the wings rufous instead of blackish.

2. *Euptychia cleophes*, sp. n.

♂. Alis fuscis, lineis duabus submarginalibus, interiore crenulata; posticis oculo ad angulum analem nigro, ochraceo circumcincto et plumbeo bipupillato: subtus fusco-grisescens lineis duabus transversis notatis, una per cellulas, altera ad finem earum fulvis; triciente distali pallidiore; lineis submarginalibus sicut in pagina superiore sed magis distinctis; anticis oculo subapicali nigro, fulvo circumcincto et plumbeo bipupillato, altero supra eum et duobus infra obsoletis; posticis oculis duobus distinctis, uno subapicali, altero inter ramos medianos, duobus obsoletis inter eos et altero apicali.

♀. mari similis, sed anticis oculo subapicali distincto ornatis et plaga ad medium marginis externi fulva: subtus anticis plaga fulva sicut in pagina superiore, lineis transversis latioribus et rufescentibus.

Hab. Mexico occidentalis (*H. H. Smith*).

This species must be compared with *E. myncea* and *E. labe*, but may be distinguished by the absence of rufous markings beneath at the anal angle of the secondaries. As in *E. labe* there is no fulvous line across the base of the secondaries beneath. The female has a distinct rufous patch near the middle of the outer margin of the primaries. Mr. Smith's collection contains several specimens, all taken at Tierra Colorada and Dos Caminos on the road to the interior from Acapulco, at the base of the Sierra Madre del Sur.

3. *Euptychia clinas*, sp. n.

Alis anticis ad apicem obtusis, margine externo concavo; posticis

marginē externo dentato, angulo anali bene producto: fuscis, anticis ad costam et marginem externum saturatioribus, posticis ad angulum apicalem quoque obscurioribus maculis tribus submarginalibus nigricantibus notatis: subtus pallidioribus et paulo rufescentioribus, lineis tribus undulatis communibus transfasciatis, una per cellulas, altera discali, tertia submarginali; posticis maculis duabus ad angulum analem rotundis, altera sagittiforme inter ramos medianos argenteis; ocellis duobus ad medium marginis externi nigris circumcinctis, maculis argenteis bipupillatis. Exp. 2.0 poll. Angl.

Hab. Mexico, Sierra Madre del Sur (*H. H. Smith*).

This very distinct species, belonging to the section of the genus containing *E. argentella* and its allies, may be readily distinguished by the dentate margin of the secondaries and the prolongation of the anal angle; the blunt apex of the primaries is also a marked feature.

Mr. Smith obtained several specimens in the higher portions of the Sierra Madre del Sur in the State of Guerrero at Omilteme, 8000 feet above the sea, and at Xucumanatlan at 7000 feet.

4. *Lymanopoda cinna*, sp. n.

Alis nigricanti-brunneis; anticis maculis tribus subapicalibus, una ad angulum analem et duabus discalibus inter ramos medianos; posticis ad basin læte cæruleo lavatis: subtus rufo-castaneis; anticis ad marginem externum pallidioribus, maculis albis sicut in pagina superiore, sed majoribus et omnibus (præter eam costæ proximam) nigro circumcinctis, macula pallida nigro circumcincta ad cellule finem; posticarum dimidio distali fasciis indistinctis ochraceis transversis et ocellis obsoletis discalibus notatis. Exp. 2.2.

Hab. Guatemala, San Lucas Toliman, alt. 5000 feet (*G. C. Champion*).

Mr. Champion took a single male specimen of this beautiful species in the forest of the Volcano of Toliman. Its nearest ally, so far as we are aware, is *L. euopsis* of Costa Rica; but it may at once be distinguished by the blue base of the secondaries in the male. The only other species in which this colour is exhibited are the Colombian *L. samius* and *L. cæruleata*; but these species are not otherwise allied.

5. *Phyciodes alexon*, sp. n.

♂. *P. nebulosæ* affinis, sed anticarum maculis omnibus pallide flavidis (nec ferrugineis), lineis et maculis posticarum dimidii distalis quoque flavidis distinguenda.

♀ mari similis, sed major et maculis omnibus magis distinctis.

Hab. Mexico, Cuernavaca and Sierra Madre del Sur (*H. H. Smith*).

This species seems clearly allied to *P. nebulosa* (Biol. Cent.-Amer., Rhop. i. p. 205, t. xxii. figs. 13, 14), having similar elongated wings and coloration of the under surface.

6. *Phyciodes cyno*, sp. n.

P. otani similis, sed anticis maculis discalibus majoribus et plaga sericea nulla: subtus anticis (apice excepto) fere unicoloribus, lineolis ad basin et costam versus obsoletis vix notatis; posticis plerumque grisescentioribus, maculis omnibus sicut in *P. otane* sed magis distinctis.

Hab. Mexico, Orizaba (*H. J. Elwes*).

A single male specimen taken at Orizaba in March by Mr. Elwes seems undoubtedly distinct from *P. otanes*. The latter species has a silky patch on the primaries divided by the median branches; of this we see no trace in the insect we now describe. *P. sopolis* is more like *P. cyno* as regards the spots of the primaries, but beneath those wings are much more distinctly marked and thus agree with *P. otanes*.

7. *Myscelia auletes*, sp. n.

Alis nigricanti-brunneis, anticis ad basin pallidioribus, area interna a basi usque ad medium marginis interni et posticis ad basin purpurascentibus; anticis maculis subapicalibus albidis purpureo cinctis: subtus fere omnino ut in *M. cyananthe*, sed anticis ad basin inornatis.

Hab. Lower California, Pichilingue (*J. J. Walker*).

Mr. Walker, when attached to H.M.S. 'Kingfisher,' captured a single male specimen of this species in rather worn condition. So far as the coloration of the upper surface is concerned the species is a very distinct one, all of those previously described being much more freely marked with blue; this in the present insect is confined to a small area at the base of the wings. On the under surface *M. auletes* is marked almost exactly as in *M. cyananthe*.

8. *Callicore beleses*, sp. n.

C. Marchalii similis, sed fascia anticarum magis arcuata; posticis plaga magna discali nitenti-æneo ornatis: subtus linea subapicali gilva angustissima, fascia arcuata juxta eam lunulata costam haud attingente; posticis lineis omnibus nigris, multo latioribus.

Hab. Panama, Chiriqui (*Mus. Staudinger*).

Dr. Staudinger has submitted to us a single specimen of this species, which is closely allied to *C. Marchalii*, but can be readily recognized by the conspicuous metallic spot on the discal area of the secondaries. As the true *C. Marchalii* occurs abundantly in Chiriqui, and thence northward to Nicaragua, the occurrence of a second species in the same area is somewhat remarkable.

9. *Prepona Brooksiana*, sp. n.

♀. Alis fusco-nigris, fascia lata communi per medium alarum (latiore in posticis) nitente cyanea; maculis magnis fulvis in serie submarginali positiss, iis in posticis nigro ocellatis: subtus dimidio basali, extrorsum irregulariter terminato, argenteo-cano, lineis transversis undatis nigris, dimidio distali brunneo-cinereo; anticis lineis transversis tribus nigris, una brevi ad cellulæ finem, altera bene angulata ultra eam per alam extendente, tertia exteriore et margine externo subparalleli, punctis tribus angulum analem versus nigris; posticis argenteo irroratis, ocellis duobus nigris fulvo semicircumcinctis cyaneo et albo pupillatis, una ad apicem, altera ad angulum analem, fascia submarginali communi fere obsoleta pallidiore in posticis intra ocellos, punctis tribus indistinctis cyaneis notatis. Exp. 5.

Hab. Mexico, Coatepec (*J. Brooks*).

A single female example of this beautiful and distinct species was captured by Mr. Brooks at Coatepec, and was presented by him to us together with several rare or new Lepidoptera, and we have much pleasure in naming this fine insect after its discoverer. On the upperside it somewhat reminds one of *E. deiphile* of South-east Brazil, having a similar submarginal row of fulvous spots; but here the resemblance ends, for it has a broad blue stripe crossing the centre of both wings, instead of the whole of the interior being suffused with purple; the markings too of the underside are quite different, and it does not appear to be very closely allied to any other species. The male is at present unknown.

10. *Prepona ælia*, sp. n.

Alis nigricantibus, fascia communi mediana nitente cyanea; posticis maculis duabus parvis ad angulum analem aliisque obsoletis submarginalibus cyaneis; subtus sericeo-cinereo-brunneis fere unicoloribus, dimidio basali lineis paucis nigris irregulariter transfasciatis; posticis maculis ad angulum analem cyaneis et ad marginem externum sicut in pagina superiore. Exp. 4.

Hab. Mexico, Coatepec (*J. Brooks*).

We have a single male specimen kindly given us by Mr. Brooks of Coatepec. It resembles in some respects *P. synchrona* of Staudinger and has a similar distribution of blue on the upper surface of the wings; but the secondaries have no obsolete submarginal fulvous spots as in that species. Beneath the wings are nearly uniformly coloured, instead of being divided into two tints by a sharply defined straight transverse line.

11. *Eurygona cheles*, sp. n.

♀. *E. aurantiaca* similis, sed anticis area circa ramum medianum primum et cellula fusco lavatis, posticarum margine externo rotundato (haud angulato): subtus pallidioribus, linea transversa communi in anticis fere recta, in posticis magis sinuata.

♂ adhuc ignotus.

Hab. Panama, Chiriqui (*Trötsch*). Mus. Staudinger.

A single female in Dr. Staudinger's collection differs in several respects from examples of the same sex of *E. aurantiaca*, to which it is obviously allied. The male will doubtless resemble the allied form, but a difference must be looked for in the straightness or curvature of the common band on the under surface of the wings.

12. *Lymnas gynæceas*, sp. n.

Alis nigris; anticis apice flavidis, macula ad basin coccinea; posticis immaculatis præter maculam basalem coccineam: subtus ut supra; abdomine maculis quatuor coccineis utrinque notato.

Hab. Mexico, Cuesta de Misantla (*M. Trujillo*).

This species appears to be most nearly allied to *L. pive*, but may at once be distinguished by the absence of the marginal scarlet spots on the wings.

13. *Baotis nesæa*, sp. n.

Alis pallide flavis; anticis dimidio distali, costa et linea obliqua ad basin nigricantibus, limbo marginali maculis duabus flavis, una subapicali, altera ad angulum analem, macula rubra ad costæ medium; posticis margine externo late nigricante (linea flava et altera exteriore plumbea includente) cum linea basali margine interno subparallela conjuncta: subtus ut supra, maculis et lineis submarginalibus majoribus, lineis basalibus subobsoletis.

Hab. Panama, Volcán de Chiriqui (*Trötsch*).

Dr. Staudinger has submitted to us the single male speci-

men here described and figured. It has no near allies known to us, but somewhat resembles *B. felix*, Hew. The red spot on the costa of the primaries, however, is quite characteristic.

14. *Emesis brimo*, sp. n.

Alis brunneis, area discali vix sericeo nitente et lineolis nigris transversis fere ut in *E. lupina*; anticis macula quadrata ad cellulæ finem, altera costali ultra eam, margine externo late maculisque variis ad basin testaceis, maculis submarginalibus sex nigris, ea ad angulum analem duplici; posticis testaceo variegatis et maculis submarginalibus nigris notatis: subtus testaceis, maculis et lineolis nigris undique notatis.

Hab. Panama, Chiriqui (*Trötsch*, Mus. Staudinger).

Dr. Staudinger has submitted to us a single male specimen of this pretty little species, which has no near ally with which we can satisfactorily compare it. It belongs, however, to the same group as *E. lupina*, but the markings are all much more clearly defined.

15. *Lemonias idmon*, sp. n.

Alis ferrugineis ad basin paullo fusciscentioribus et nigro frequenter maculatis: subtus canescentibus ad margines externos et anticis ad costam magis fuscis; maculis nigris sicut in pagina superiore, sed maculis singulis albo-cinctis; maculis submarginalibus quoque nigris albo-cinctis, eis venæ medianæ posticarum utrinque obsoletis.

♀ mari similis, sed alis fusciscentibus ferrugineo vix tinctis.

Hab. Panama, Chiriqui (*Trötsch*).

Dr. Staudinger has sent us a male and female of this species, which is allied to *L. galena*, Bates, but the wings of the male are less ferruginous above, and beneath there is no submarginal rufous band to the secondaries; the submarginal spots also on these wings are more irregular, those on either side of the median vein being obsolete.

16. *Papilio corbis*, sp. n.

P. philenori affinis, sed posticis fere ccaudatis: subtus margine posticarum æneo-virescente, multo angustiore, maculis suis rufescentioribus distinguendus.

Hab. Mexico, Northern Yucatan (*Gaumer*).

We have several specimens of this form of *P. philenor*, including both sexes. The males have a submarginal row of

spots on the primaries, just as in the females, only rather smaller; as a rule these are not present in the males of *P. philenor*.

17. *Papilio orsua*, sp. n.

♂. *P. philenori* quoque similis, sed multo minor et alis nitide cærulescentioribus; posticis caudatis, maculis submarginalibus magis rotundatis et pure albis: subtus posticis a margine usque ad cellulam nitide cyanescentibus, maculis suis saturate rubris.

♀ mari similis, sed maculis omnibus majoribus et magis distinctis.

Hab. Mexico, Tres Marias Islands (*Forrer*).

This is also a form of *P. philenor*, probably peculiar to the Tres Marias Islands; as in *P. corbis* the tails of the secondaries are not developed, but it differs from that species in the bluer tint of its wings, the spots of the hind wings being of a clearer white and further from the outer margin, and beneath the metallic blue margin of the secondaries is much wider, extending up to the cell. On the opposite mainland at Acapulco and Mazatlan the true *P. philenor* is found.

XL.—Description of a new Species of the singular Lepidopterous Genus *Mastigophorus*. By A. G. BUTLER, F.L.S., F.Z.S., &c.

THE genus *Mastigophorus* was founded by Poey (Cent. Lep. Cuba, pl. viii.) for the reception of a small Deltoid moth—*M. parra*.

This genus, incorrectly quoted by Guénée and Walker as *Mastigophora* (*sic*), is characterized by extraordinarily elongated, reflexed, and fringed palpi, slender antennæ with well-defined conical joints, the anterior angles of which are furnished on each side with a delicate short hair, and the tibiæ of the anterior legs terminating in a dense pencil of short hairs; the last-mentioned character and the entire instead of angulated primaries seem alone to distinguish it from *Palthis*, Hübn., = *Clanyma*, Guén., = *Mardara*, Walk.

The species now to be described is allied to *M. lycayusalis* of Walker = *Bertula*? *monstrosalis* of Felder and Rogenhofer, from Venezuela, but differs in its much deeper colouring, narrower and simply white-edged reniform spot, simply angu-

lated bisinuated postmedian band, and prominent macular black discal stripe on the primaries, the darker-bordered and more distinctly pale-banded secondaries, and the flexuous instead of angular, regularly densely fringed palpi terminating in a shorter brush-bearing joint.



Mastigophorus mirabilis, sp. n.

♂. Primaries dark greyish piceous; a short arched irregular black line, edged externally with ochreous, close to the base; an unequally trisinuated, externally black-bordered, ochreous line at about the basal fourth representing the inner limitation of the central belt; a tricoloured angulated band flesh-colour, black and ochreous, immediately beyond the middle, impinged upon by the reniform spot and representing the outer limitation of the central belt; orbicular spot represented by a pure white dot with black margin, in the middle of the discoidal cell; reniform spot narrow, angular in front, brown, almost entirely edged with pure white, so as to represent an irregular white **R**; a black patch from just above the angle of the postmedian band to a slender and indistinct undulated ochreous discal line, which bounds a series of large and for the most part confluent black spots, which form a bisinuated band from apex almost to external angle; a marginal series of small subconfluent black spots, followed by an ochreous line at the base of the fringe: secondaries smoky grey, the external third much darker, bounded internally by a pale diffused stripe and traversed by a slightly dentate-sinuated whitish line; a marginal series of black lunules, followed by a yellowish-white line at base of fringe: head and thorax dark piceous; palpi ochraceous, the fringes tipped with black; abdomen smoky greyish brown, darker towards the base, the segments edged with whitish; legs blackish, banded with ochraceous or yellowish white above, white

brown below. Primaries below greyish fuliginous, with a large apical costal black patch, traversed by a zigzag ochreous line and preceded by an ochreous patch divided by an arched blackish stripe; costal border ochreous, with two short black basicostal dashes; a blackish dot at the end of the cell; marginal dots and fringe nearly as above: secondaries whitish brown, costal and external areas slightly sandy, irrorated with blackish; two black dots in the cell, followed by a black spot at the end of the cell; three parallel, zigzag, dark grey stripes beyond the middle; a marginal series of triangular black spots; fringe brownish, traversed by two grey stripes: base of palpi below blackish piceous: body below greyish brown, venter with paler edges to the segments. Expanse of wings 34 millim.

The specimen was from Gordon Town. Mr. Fawcett, Director of Public Gardens, Jamaica.

XLI.—*Descriptions of two new Coleoptera in the British Museum (Buprestidæ and Rutelidæ).* By CHARLES O. WATERHOUSE.

Rutelidæ.

Anoplognathus aureus.

Oblongo-ovalis, politus, aureus; capite tenuiter punctato; ore, antennis pedibusque testaceis.

Long. 15 millim.

Hab. Queensland.

This beautiful species most nearly approaches my *A. parvulus*, but is still smaller, rather more convex, and entirely of a brassy-gold colour without any green tint. The head is finely and not very densely punctured; the clypeus is transverse, obliquely narrowed in front, with the angles only slightly prominent, the margin reflexed. The thorax is almost impunctate, less angular at the sides than in *A. parvulus*, and the base and anterior border are only margined near the angles. The elytra have only one or two lines of punctures at the sides; the margins are not reflexed at the middle. The pygidium has a few distant punctures; the apex has some long pale hairs. The mesosternal process is considerably longer than in *A. parvulus*.

This species is, I believe, well known, and I have been told that it is described; I have, however, searched in vain for any description of it, and if by any unfortunate accident I have overlooked it, or it is in any paper which has not come into my hands, I must apologize beforehand for making a synonym.

Buprestidæ.

Sternocera Hunteri.

Nigro-cyanea, nitida; thorace crebre punctato, antice foveolato; elytris castaneo-flavis, striato-punctatis, macula obliqua subhumerali apiceque nigro-cyaneis.

Long. 16-19 lin.

Hab. East Africa, Masailand (*H. C. V. Hunter, Esq.*).

Form of *S. orissa*. The thorax has the punctures at the base small and slightly separated from each other (the intervals flat); towards the front the punctures become gradually larger, but are very irregular, the intervals convex, varying in width but not costiform. The elytra have lines of rather small but distinct punctures, the intervals are very finely and not closely punctured; the apex is coarsely and closely punctured; brownish yellow, with the apical third blue-black and with an oblique blue-black patch below the shoulder, the blue-black colour being continued along the margin to the apex. Abdomen coarsely and closely (but not deeply) punctured.

Sternocera Hunteri, var. *fasciata*.

This differs from the foregoing in having the elytra less regularly punctured in lines, and it has a broad blue-black band near the base, *not* extending to the margin. The apical area is blue-black, but the line of demarcation, instead of being nearly straight and ascending as it approaches the suture, is trisinate and descends at the suture. The abdomen is less deeply punctured.

XLII.—Notice of a new Fish from the Issik Kul (*Diptychus Lansdelli*). By Dr. A. GÜNTHER.

THE Rev. H. Lansdell has discovered during his recent travels in Central Asia a new species of the singular genus *Diptychus*, one of the most characteristic forms of the Central-

Asiatic fauna, in the Issik Kul or one of its affluents. This is the fourth species known at present of this genus.

Diptychus Lansdelli.

D. 11. A. 7. P. 18. V. 10. L. lat. 80-90.

Nearly the whole body is naked, the parts above the lateral line being quite scaleless; but there are a few scales between the lateral line and the root of the pectoral fin, a few scattered scales on the abdomen, and a series of larger ones running on each side of the vent and the anal fin. The scales of the lateral line are distinct enough in its anterior part, but rudimentary behind.

The body is low, loach-like, its greatest depth being only one sixth or nearly one sixth of the total length (without caudal); the length of the head is contained four times and a quarter in it and exceeds the length of the caudal peduncle. Interorbital space very broad, its width being equal to the length of the snout. The diameter of the eye is one sixth of the length of the head and rather less than two thirds of that of the snout. Mouth semicircular, quite at the lower side of the snout. Barbel about as long as the eye. The dorsal fin is as long as high, its origin being equidistant from the end of the snout and from the end of the caudal peduncle. Caudal fin deeply forked. Pectoral fin reaching to the origin of the dorsal, ventral fin nearly to the vent. The outer ventral ray is opposite to or a little behind the last dorsal ray.

The upper two thirds of the body of this species are covered with deep black spots, the largest of which are half the size of the eye.

The largest of the specimens is 12 inches long; its anal rays are covered with seasonal epidermoid tubercles, arranged in a series along each ray.

XLIII.—*Description of a new Bat from the Gambia.*

By OLDFIELD THOMAS.

Vesperugo (Vesperus) Rendalli, sp. n.

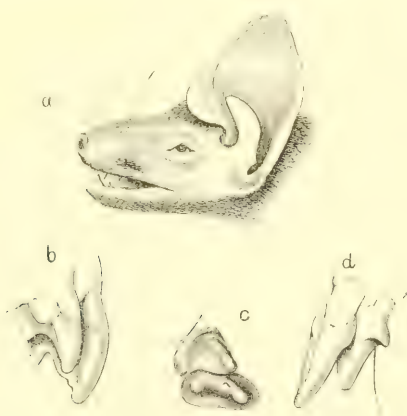
Crown of the head flat, scarcely raised above the level of the muzzle; muzzle broad, the glandular prominences much swollen. Ears short; laid forward they reach barely more

than one half the distance between the eye and the tip of the nose; their inner margin straight, tip narrowly rounded off, upper third of outer margin straight, middle third slightly convex, basal third with a marked lobe separated by a notch opposite the base of the tragus.

Tragus of about the same breadth from base to tip, its inner margin evenly but slightly concave, its tip rounded, its outer margin evenly convex, its base with a triangular lobule; when laid forward its tip reaches to between the posterior canthus and the middle of the eye.

Pads at the bases of the thumbs scarcely more marked than usual, but the soles of the feet broad, swollen, and wrinkled, projecting posteriorly behind the level of the origin of the calcaneum. Wings from the metacarpus close to the base of the toes. Calcaneum reaching about halfway from the heel to the end of the tail, its tip forming a small projecting point like that found in *V. Daubentoni*; postcalcaneal lobule distinct, but rather narrow. Tail involved in the interfemoral membrane to its extreme tip. Penis with a distinct bone.

Fur scarcely extending on the membranes except on the interfemoral in the centre below.



Vesperugo Rendalli. *a*, head, twice natural size; *b-d*, upper incisors, much magnified; *b*, of right side, outer view; *c*, of right side, buccal view; *d*, of left side, front view.

Colour of body, above and below, of the skin of the forearm, digits, and legs greyish brown, of the membranes everywhere white, the reticulations well marked.

Teeth.—Upper incisors (figs. *b-d*), or at least the outer

pair, quite different from those of any other member of the genus. The inner one with a large secondary cusp about halfway up its posterior edge, and the hinder edge of the main cusp, above the secondary one, markedly sinuous, as though the tooth were occasionally trifid (fig. *b*). Outer incisor well developed, triangular in section at the base (see fig. *c*), its angles each with a cusp, the antero-internal bearing the long main cusp, three fourths the height of the inner incisor; cusp on the postero-internal angle about half the height of the secondary cusp of the inner incisor; cusp on the external angle minute, but quite distinct (fig. *d*); postero-external side of the tooth close to the base of the canine (fig. *e*). No trace of a minute anterior premolar; large premolar pressed closely against the back of the canine and leaving no room for another tooth between.

Lower incisors trifid, overlapping, placed at right angles to the direction of the jaws. Second lower premolar two thirds the height of the canine, and first premolar two thirds its height.

Dimensions of the type (an adult male in spirit):—Head and body 50 millim.; tail 39; forearm 36 (=1.4 inch); head 16.5; muzzle to eye 7.0; ear, above crown 9.0, from base of external margin 13.0; thumb, including claw, 6.2; lower leg 13.6.

The type specimen of this most interesting bat was obtained by my friend Dr. Percy Rendall at Bathurst, on the River Gambia, and I have much pleasure in connecting his name with it.

Vesperugo Rendalli presents a combination of characters which prevents it falling into any one of the subgenera of *Vesperugo* as recognized and defined by Dr. Dobson (Cat. Chir. B. M. p. 184). But I am far from regarding it as representing a new subgenus, and only consider it as showing that *Hesperoptenus*, Peters, in which a penis-bone is present and the outer incisors are minute, should be amalgamated with *Vesperus*, in which there is no penis-bone and the outer incisors are well developed. The swollen and probably adhesive hinder pads of this species give it a second point of resemblance to *V.* ("*Hesperoptenus*") *Blanfordi*, Dobs.; but, as Dr. Dobson has shown, this character is not one on which generic or subgeneric division can be based.

BIBLIOGRAPHICAL NOTICE.

Manual of British Birds. By HOWARD SAUNDERS. Parts I.-XII.
London: Gurney and Jackson.

WHEN the fourth edition of Yarrell's 'History of British Birds' was brought to a conclusion four years ago, the chief drawback, in the eyes of many, was its costliness, due in a great measure to the illustrations. It was evident that with the successors of Mr. Van Voorst, the proprietors of the blocks, must rest the production of a cheaper book, in which the bulk of the matter should be incorporated in a smaller compass; but it was doubtful whether a plan could be evolved at once satisfactory and remunerative. However, by strictly limiting the articles on each species to two pages, inclusive of the woodcut, it was found that a volume of some 800 pp. might be furnished at the price of about £1; and, though this method was sure to carry objections on the score of brevity to the minds of a certain class of critics, we cannot but think that all is included which is necessary for the readers to whom the work appeals, while the result has proved equally creditable to the energy of the author and the enterprise of the publishers. Excellent alike in style and matter, it ought to be in the hands of every lover of birds, and should take the place of several inferior books on the subject now before the public. Since last April twelve parts have been issued, the monthly appearance of which has been characterized by the utmost regularity.

No better model on which to base the work could have been adopted than that offered by Prof. Newton's portion of the fourth edition of "Yarrell;" but, on comparison, it is quite obvious that the subject of our present notice has been completely rewritten, while the arrangement also differs somewhat, the system followed being in the main that of the British Ornithologists' Union List, which has at least the sanction of authority.

Migration reports are responsible for much fresh information, and the author has evidently availed himself of the writings of Bogdanow, Büchner, Giglioli, Gröndal, Fischer and v. Pelzeln, Menzbier, Prjevalski, and Winge. Aided by these and others, the range of perhaps half our species has been more or less extended and, in some cases, corrected; that of near allies has been elucidated or more accurately defined, and the lines of contact sketched out. The species figured as new are the Isabelline, Black-throated, and Desert Wheatears, the Barred Warbler, the Wall-Creeper, the Needle-tailed Swift, and the Lesser Kestrel; while the Marsh Warbler, the Red-throated Pipit, the Red-necked and Egyptian Nightjars, the American Green-winged and Blue-winged Teals are inserted without cuts; but the St.-Kilda Wren is only mentioned to be dismissed. The Marsh-Harrier, Goshawk, and Merlin are also figured afresh. Among our rarer visitors we notice further examples of the Yellow-browed, Rufous, Icterine, and Great Reed-Warblers, the Water-Pipit, the

Lesser Grey Shrike, the Red-breasted Flycatcher, the Black-headed, Rustic, and Ortolan Buntings, the Great White Heron (Scotland), the Ruddy Shield-Duck, the King Eider, and the Harlequin Duck. On the other hand, the following species are omitted, with the exception of brief notices (not always under the corresponding genus):—the Gold-vented Thrush, the Purple Martin, the Parrot and American White-winged Crossbills, the Red-winged Starling, the Belted Kingfisher, the Yellow-billed Cuckoo, the Swallow-tailed Kite, the Canada, Spur-winged, and Egyptian Geese, the Polish Swan, and the Passenger Pigeon. The only vignettes retained are those of *Anthus rupestris*, *Neophron percnopterus* (juv.), the head and foot of the Nightjar, and the foot and breast-bone of the Swift.

Stronger proof is adduced of the specific identity of the various Dippers, a young Bittern in the down is recorded from Norfolk and a specimen of *Anser erythropus* from Northumberland, the nesting of the Brambling and the Pintail in Scotland on one occasion, and of the Snow-Bunting on two, is substantiated, the Kestrel is stated to have built on the ground and Spoonbills on trees at Fulham, and the recent irruption of the Sand-Grouse is duly chronicled; while critical distinctions between the species are not unfrequently italicized, and new details abound with regard to food, habits, interbreeding, number of broods or eggs, and time of nesting. The distribution of many birds in Britain is also considerably at variance with the older records, notably that of the Marsh-Harrier in Scotland.

As errors we may mention the omission of measurements in the Wall-Creeper and some confusion of language in respect to the Cuckoo's foster-parents, while we are sorry to see the American *Plectrophenax* substituted for *Plectrophanes*.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

December 19, 1888.—W. T. Blanford, LL.D., F.R.S.,
President, in the Chair.

The following communications were read:—

1. "*Trigonocrinus*, a new Genus of Crinoidea from the 'Weisser Jura' of Bavaria, with description of a new species, *T. liratus*; Appendix I. Sudden deviations from normal symmetry in Neocrinoidea; and Appendix II. *Marsupites testudinarius*, Schl., sp." By F. A. Bather, Esq., B.A., F.G.S.

This genus is proposed on the evidence of two calyces in the British Museum (Natural History) which were found among specimens of *Eugeniocrinus* from Streitberg. The species of *Eugeniocrinus*, *Phyllocrinus*, and *Trigonocrinus* may be arranged in a series which is apparently one of evolution. The present genus is there-

fore to be placed with the *Eugeniocrinidæ*, although its characters are not those of the family as heretofore defined. This is seen from the following diagnosis :—

Trigonoerinus, gen. nov.—Calyx roughly triangular or trilobate in section. Basals 4, but one so atrophied as to be almost invisible; all fused into a basal ring. First radials 4; the two on either side of the smallest basal half the size of the others, thus maintaining the triangular symmetry; all closely united, with each suture-line in a groove. Processes of radials well developed, forming spines homologous with the petals of *Phyllocrinus*; except the adjacent processes of the smaller radials, which only form a minute ridge. Articular surface of radials curved gently inwards and upwards; muscular impressions indistinct or absent; no articular ridge; no canal-aperture. Arms unknown; ? represented by fleshy appendages. Calyceal cavity contained in first radials; with small round ventral aperture, surrounded by a rim, which is the only relic of a muscular attachment. Stem unknown.

The two calyces belong to the same species, viz. *T. liratus*, sp. nov. —Calyx rather more elongate than in the known species of *Phyllocrinus*; basals ornamented with minute granules; radials ornamented with similar granules run into curved ridges, which, owing to their differing intensity, give an imbricated appearance; spines triangular in section, with the base of the triangle directed inwards, the apex outwards, the angles often rounded.

The differentiation of *Trigonoerinus* from the central *Eugeniocrinid* type has been effected on the one hand in accordance with the principles of "Degeneration," "Reversion," and "Use and Disuse": while, on the other hand, it exemplifies certain methods of change in organic forms, which may be referred to the categories of (1) Sport, (2) Hypertrophy and Atrophy, (3) Fusion and Fission. Thus considered it is of unique interest among Crinoidea. An examination of the variations in symmetry presented by the Echinodermata suggests the conclusion that the Pentamerous type was originally evolved from another system, or at least that it was selected from among other variations, that it has survived, and that it has been kept true, as being the fittest.

Appendix I. Sudden deviations from normal symmetry in Neocrinoidea.

A collection of instances from previous authors, with a few additions, the whole illustrating the latter portion of the paper.

Appendix II. On *Marsupites testudinarius*, von Schlotheim, sp.

A synonymy of the genus *Marsupites*; it contains but one known species, and all other names must yield to this one.

2. "On *Archæocyathus*, Billings, and on other Genera allied thereto or associated therewith from the Cambrian Strata of North America, Spain, Sardinia, and Scotland." By Dr. G. J. Hinde, F.G.S.

A revision of the type specimens of the three species included by Mr. Billings in the genus *Archæocyathus* shows that each of the

species represents a distinct genus. *Archæocyathus profundus*, having been selected by Mr. Billings in 1865 as the typical species, was retained as such, and the characters of the genus, as shown in this species were defined; *Arch. atlanticus*, Bill., was made the type of a new genus, *Spirocycathus*; and the third species, *Arch. minganensis*, which proves to be a siliceous sponge, was included in a new genus, *Archæoscyphia*.

Including the genera allied to *Archæocyathus*, described by Meek and Bornemann, the following constitute the family ARCHÆOCYATHINÆ, proposed by this last-named author; *Archæocyathus*, Bill.; *Ethmophyllum*, Meek; *Coscinocyathus*, Born.; *Anthomorpha*, Born.; *Protopharetra*, Born.; and *Spirocycathus*, g. n.

The genera of this family are characterized for the most part by turbinate or subcylindrical forms with stout walls enclosing an interior tubular or cup-shaped cavity. Their skeletons are of carbonate of lime in a minutely granular condition. The walls in the first four of the above-named genera consist of an outer and an inner lamina connected by vertical and radial septa; dissepiments are generally present between the septa; save in the genus *Anthomorpha*, the outer lamina of the wall is regularly and minutely perforate, and the inner lamina and septa are likewise cribriform; *Ethmophyllum* is particularly distinguished by oblique canals connecting the interspaces of the wall with the central cavity, *Coscinocyathus* by transverse, perforate tabulæ, and *Anthomorpha* by the apparently imperforate character of the surface-lamina and septa. *Protopharetra* and *Spirocycathus* are either non-septate or very obscurely septate; their skeleton consists of anastomosing laminae and fibres; in the latter genus the laminae are remarkably thickened by successive secondary deposits of calcareous material.

The Archæocyathinæ are regarded as a special family of the *Zoantharia sclerodermata*, in some features allied to the group of perforate corals. The family is restricted, so far as is known at present, to the lowest fossiliferous zone of the Cambrian strata, that characterized by the genus *Olenellus*, Hall, and it occurs at Anse-au-loup, Labrador; Troy, New York State; Nevada; in the Sierra Morena, Spain; and in the south-west of the Island of Sardinia.

The genus *Archæoscyphia*, based on *Archæocyathus minganensis*, Bill., is shown to be a lithistid sponge, and *Nipterella*, g. n., based on *Calathium* (?) *paradoxicum*, Bill., belongs likewise to the same group of sponges. The genera *Calathium*, Bill., and *Trichospongia*, Bill., are also undoubted siliceous sponges. These various sponges, which were either included in *Archæocyathus* by Mr. Billings, or regarded as allied thereto, have no relation whatever to the genus, or to any member of the family in which it is included. They come from a higher geological horizon, the Calceiferous formation of the Canadian geologists, which is probably the summit of the Cambrian. They occur in the Mingan Islands and in Newfoundland. *Archæoscyphia* and *Calathium* are present in the Durness limestones.

January 23, 1889.—W. T. Blanford, LL.D., F.R.S.,
President, in the Chair.

The following communications were read:—

1. "On Remains of Eocene and Mesozoic Chelonia, and on a Tooth of (?) *Ornithopsis*." By R. Lydekker, Esq., B.A., F.G.S.

This communication treated in the first place of remains of Chelonia from the Cambridge Greensand, Wealden, and London Clay. Firstly, *Rhinochelys*, from the Cambridge Greensand, was considered to indicate a Pleurodiran type: and four new specific names were proposed, viz. *R. macrorhina*, *R. brachyrhina*, *R. Jessoni*, and *R. cantabrigiensis*. From the same deposits a skull was described which was considered to indicate a new species of *Chelone*, for which the name *C. Jessoni* was proposed. Other remains of marine Chelonians from these beds were regarded as indicating a Turtle allied to the Loggerhead, and were provisionally referred to the genus *Lytoloma*, as *L. cantabrigiense*. In the course of the description, it was proposed to replace the name *Euclastes* (preoccupied) by *Lytoloma*.

Of other Chelonidæ, the new generic name *Argillochelys* was proposed for *Chelone cuneiceps*, Owen, of the London Clay, which would also include some other forms from the same beds.

A shell of a *Plesiochelys* from the Wealden of the Isle of Wight was regarded as indicating a new species, which was named *P. Brodieri*.

It was also shown that *Chelone gigans*, Owen, of the London Clay, did not belong to the Chelonidæ at all, but indicated a species of the genus *Psephophorus*—a member of the Dermatohelydidae.

The next section of the paper described a peculiar mandibular symphysis from the London Clay, which was taken to indicate a new genus of Chelonia, to be named *Dacochelys*; and it was suggested that *Emys Delabechei*, Owen, might be the same form.

The paper concluded with a notice of a tooth from the Wealden, of the same general type as one previously referred by the author to *Ornithopsis*; and it was shown that teeth from the Portlandian of Boulogne, which had been described as *Neosodon* and *Caulodon*, and regarded as Iguanodont, were likewise of the same general type. It was also shown that *Cardiodon*, Owen, from the Forest Marble, belonged to the same group.

2. "On the Dentition of *Lepidotus maximus*, Wagn., as indicated by specimens from the Kimridge Clay of Shotover Hill, near Oxford." By R. Etheridge, Esq., F.R.S., F.G.S., and H. Willett, Esq., F.G.S.

The paper commenced with a list of fourteen species of *Lepidotus* known in England, from beds between the Lias and Upper Chalk inclusive, and an account of the range of the Lepidosteoid fishes from Permian times to the present day followed. The occurrence

of separate teeth of *Lepidotus maximus*, Wagn. (= *Sphaerodus gigas*, Ag.), in the *Eroggyra-virgula* zone of Shotover and Kimeridge has been previously recorded; but in the present communication four specimens of jaws containing teeth were noticed.

I. Comprises the upper dentition; it belongs to the same species and, possibly, to the same individual as No. IV. Eighteen teeth occur in its two fragments.

II. Contains two teeth, an upper and a lower, belonging to the same species as No. IV.

III. Probably the right dentary bone, appears to belong to a distinct species. It is very perfect, and exhibits sixteen teeth, of which the successors of six are exposed on the underside. The marginal series comprises the seven smallest teeth, those placed most inwardly being the largest. Compared with the dentary bone of those species of which that element is already known, the fossil approaches most closely to *Lepidotus maximus*, Wagn., but the bone is broader in proportion to its length, and the teeth are more numerous.

IV. Corresponds undoubtedly to *Lepidotus maximus*, Wagn. The dentition of this specimen does not, however, appear to belong to the left upper jaw, but to the dentary bone. Its upper surface contains seventeen teeth, and the lower, or successional, series consists of fifteen, = 32 in position.

MISCELLANEOUS.

New Trichopterygidæ.

WHEN I wrote my paper on "New Trichopterygidæ" (Ann. & Mag. Nat. Hist. March 1889, pp. 188-195) I supposed that the labels bearing the name "Blumenau," attached to all the specimens received from Herr E. Reitter, referred to their captor; but I have since discovered that they refer to the place in which he resided and not to the man himself.

In consequence of this mistake the following errata have occurred, viz. :—

P. 191, lines 5 & 6 from top, for "made by Herr Blumenau in Brazil" read "from Blumenau in Brazil."

| | |
|-----------------|--|
| P. 191, line 22 | } for "by Herr Blumenau" read "near Blumenau." |
| P. 192, " 22 | |
| P. 193, " 12 | |
| P. 193, " 25 | |

A. MATTHEWS.

Gumley,
March 23, 1889.

On some new Entomophthoræ. By M. A. GIARD.

The species of Entomophthoræ are much more numerous than is generally supposed. During the last summer (1888) I observed some new forms, of which I may indicate the following, which will shortly be figured and described in more detail.

1. *Entomophthora saccharina*.

This species was collected this summer in the dune of Ambleteuse. It is parasitic in the caterpillar of *Euchelia Jacobee*. That species, which is always common at Wimereux, was very abundant this year, and nearly all the examples of *Senecio Jacobeus*, var. *candicans*, were so infested by it as to be almost denuded. I have met with the *Entomophthora*, however, only in a space of about 20 square metres. The dead caterpillars were attached to the branches of the groundsel generally with the head downwards, but also not unfrequently in the normal position. The conidian spores form small masses of saccharine aspect upon the hairs of the infested caterpillars. They measure 17–18 μ in their largest diameter and are pyriform. The zygospores, which are very abundant in the interior of the caterpillar, have a very thick wall; they are irregularly spherical and 21 μ in diameter; the hyphæ measure 7–10 μ .

2. *Entomophthora Plusiae*.

Last July the caterpillar of *Plusia gamma* caused considerable damage in the department of the Cher, especially at Herry. Out of about fifteen caterpillars sent to me from this locality six during their journey or soon after their arrival manifested a parasitic disease which I at first attributed to a *Botrytis**, but which is due to an *Entomophthora*. The caterpillars attacked present a velvety aspect like that of certain plants with succulent hairs; further, the tufts formed by the hyphæ give the integuments a wrinkled and vermiculate aspect. An Acarian nearly allied to *Tyroglyphus mycetophagus*, Megnin, is very abundant upon the infested caterpillars and probably assists in the propagation of the fungus, of which it transports conidia. Some caterpillars were infested by a Dipteran (*Exorista vulgaris*, Fall.); they were not attacked by the *Entomophthora*.

3. *Metarhizium chrysorrheæ*.

The caterpillars of *Liparis chrysorrheæ*, Linn., living upon the oaks of the Jardin d'Acclimatation in the Bois de Boulogne, were to a great extent destroyed during the months of June and July by a fungus which I refer to the genus *Metarhizium*, Sorokine. The infested caterpillars strewed the surface of the ground or went to perish against the railings serving to enclose the animals. They contained unicellular hyphæ of a brownish colour, terminated by small, irregularly ovoid conidia, measuring 5 μ in length by 3 μ in breadth, and generally containing two refringent oily globules. The external aspect of the caterpillars was but little altered. They only appeared to be a little indurated and shrivelled, and the hairs had a slightly pulverulent aspect.

* 'Journal de l'Agriculture' (Barral), July 21, 1888, p. 89.

4. *Metarhizium Leptophyei*.

I found this curious Cryptogam upon a rather rare Orthopteron, *Leptophyes punctatissima*, Bose, which lives upon elms and arrives at the adult state quite late in the season. I met with the infested specimens in an alley of the wood of Meudon in the month of October. They were attached to the lower surface of the leaves, parallel to the median vein, and with the head turned towards the petiole. The mycelium of the fungus is very distinctly pluricellular; the spores are of two kinds; some are very small, shortly ovoid conidia; the others, rather larger (6–8 μ), elongate-ovoid and divided into two by a transverse septum. The fungus presents numerous rhizoides, which cause the insect to adhere by nearly all its ventral surface.—*Comptes Rendus des Séances de la Société de Biologie*, November 24, 1888.

On the Origin of the Unionidæ. By Prof. M. NEUMAYR.

There can be no doubt upon the point that the great stock of the Mollusca was originally developed in the sea and that those forms which dwell in the fresh waters and on solid ground represent altered descendants of original inhabitants of the sea. But when we attempt to establish in detail the origin of the different groups of terrestrial and freshwater Mollusca we come upon difficulties; and even if we have succeeded in recognizing the origin of several of the smaller groups, such as *Adacna*, *Neritina*, *Dreissena*, and *Potamomya*, this has as yet proved impossible in the case of those main groups which are richest in species and most widely distributed.

In the present article it will be attempted to prove that the most widely distributed and important family of freshwater bivalves, the family Unionidæ, is descended from the marine genus *Trigonia*. The structure of the hinge is of decisive significance; in this respect *Trigonia* is distinguished by a peculiar type in the arrangement of the teeth, characterized as the Schizodont type. In the Unionidæ the hinge-structure is exceedingly variable; but if we closely examine the normal forms it appears that they may be referred without any violence to the Schizodont type, although certainly in others very important secondary modifications occur which veil the original character.

In other characters also *Uniones* and *Trigoniæ* show much affinity, as in the structure of the branchiæ, the separation of the two lobes of the mantle, the absence of siphons, &c. In the structure of the shell they show great agreement in the extraordinary development of the nacreous shell, the presence of a strong epidermis, and the arrangement of the muscular scars. It is particularly remarkable that in many geologically young *Uniones* of Pliocene and recent times shell-ornaments appear as retrogressive structures, such as occur elsewhere only in the *Trigoniæ* in the whole domain of the Conchifera.—*Anzeiger k. Akad. Wiss. Wien*, January 10, 1889, p. 4.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 17. MAY 1889.

XLIV.—*Notes on the Palaeozoic Bivalved Entomostraca.*—
No. XXVII. *On some North-American (Canadian) Species.*
By Prof. T. RUPERT JONES, F.R.S., F.G.S.

[Plates XVI. & XVII. *]

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Introduction.

Two local collections of Primitian and Beyrichian Ostracoda were sent by Mr. J. F. Whiteaves, F.G.S., of the Geological Survey of Canada, some time ago for my examination; and they have again and again occupied my leisure,

* These Plates have been drawn with the aid of a grant from the Royal Society for the illustration of the fossil Ostracoda.

being difficult of determination on account of their presenting passage-forms with gradational characters, some of which are at first sight apparently distinct enough for specification, but, really failing in their distinctness, are not in every case easily reduced to a satisfactory serial order. On this account all the more definite variations in the two sets of specimens have been carefully represented in the two accompanying Plates*. Plate XVI. illustrates a gradational series (nine in number) of true *Primitie* from the Lower-Devonian strata of Campbellton, New Brunswick; and in Plate XVII. figs. 1-9 show a collection of Primitian and Beyrichian forms, and fig. 11 an *Isochilina*, from the Upper-Silurian (Lower-Heldenberg) strata of Cap Bon-Ami, Dalhousie, New Brunswick. The two localities are about 16 miles apart, and in each case the specimens were collected by Mr. A. H. Foord, F.G.S., within a limited area of a few square yards.

The matrix of the specimens from Cap Bon-Ami (nos. 24-32) is a greenish-grey argillaceous limestone (or calcareous shale), with remnants of brachiopods and mollusks. Those from Campbellton (nos. 1-23) consist of hard shale, calcareous where shells and bones have been; some (nos. 7, 15, 21, 22) are brownish and somewhat ferruginous, the others dark grey. Several contain plant-remains and fish-bones and some have small gasteropods.

The following extracts give all that was known about the geology of the localities referred to when the specimens were collected:—

‘Canadian Naturalist and Geologist,’ vol. x. no. 2, December 1881, p. 93 —“On some Fossil Fishes, Crustacea, and Mollusca from the [Lower] Devonian Rocks at Campbellton, N.B.; with Descriptions of five new Species.” By J. F. Whiteaves.

Fossil fishes had been found by Mr. Ellis “in argillaceous and brecciated limestones † [limestone-breccia] on the south bank of the Restigouche River, about half a mile above Campbellton.” Here Mr. Foord soon afterwards found Entomostraca, besides fish-remains, a *Spirorbis*, and two small species of Gasteropoda.

‘Geological Survey of Canada.—The Fossil Plants of the Erian (Devonian) and Upper-Silurian Formations of Canada.’

* Mr. C. Davies Sherborn, F.G.S., has helped me in sorting, sketching, and collating these Canadian Entomostraca.

† “The rock is for the most part a dolomitic agglomerate [breccia] passing upwards into coarse shales and associated with felsitic and trappean beds.”

By J. W. Dawson, C.M.G. &c. Part ii. 8vo. Montreal, 1882, p. 96. "Erian and Upper-Silurian Plants from the Restigouche River and the Baie des Chaleurs.

"At Cape Bon-Ami, near Dalhousie [New Brunswick], a fine section is exposed of bedded doleritic traps, alternating with bands of limestone and shale abounding in marine fossils. These, as determined by the late Mr. Billings, are characteristic of the Upper-Silurian period and of the Lower-Helderberg group*. Some of the upper beds of this series include fragments of fossil plants, showing the structure of *Prototaxites* and detached specimens of *Pachytheca* (*Ætheotesta* †). At Cape Bon-Ami these beds are succeeded, apparently conformably, by a great thickness of reddish porphyry and porphyritic breccia, forming the Lighthouse Point at Dalhousie.

"Further up the Restigouche River, however, in the vicinity of Campbellton, where similar rocks occur, they are overlain by calcareous and magnesian breccia or agglomerate, hard shales, conglomerates, and sandstones of Lower Devonian age. The agglomerate [breccia] and lower shales contain abundant remains of fishes of the genera *Cephalaspis* [*campbelltonensis*, Whiteaves], *Coccosteus* [*aculeus*, Whiteaves], *Ctenacanthus*, and *Homacanthus*, and also fragments of *Pterygotus*. The shales and sandstones abound in remains of *Psilophyton*, with which are *Prototaxites*, *Arthrostroma*, and *Leptophloeum*, of the same species as those found in the Lower Devonian of Gaspé Bay."

I. Lower-Devonian Specimens from Campbellton, New Brunswick.

These are magnified 15 diam. in Plate XVI. and therefore look larger than those from Cap Bon-Ami in Plate XVII., which were magnified only 10 diam., so as to allow the two large forms, figs. 10 and 11, to be included in that Plate. For the material of the specimens (nos. 1-23) see above, p. 374.

1. *Primitia mundula*, Jones, varieties. (Pl. XVI. figs. 1, 2, 4-9, and woodcut, fig. 2.)

The *Primitiæ* from Campbellton are certainly closely allied together, and, excepting fig. 3, do not differ much from *Primitia mundula*, Jones (Ann. & Mag. Nat. Hist. ser. 2,

* "Acadian Geology," p. 579."

† "Fruit of *Prototaxites*?"

vol. xvi. 1855, pp. 90 and 174, pl. v. fig. 23, and pl. vi. figs. 28-31; and ser. 3, vol. xvi. 1865, p. 419), in one or other of its modifications, as described in 1865. See also Proc. Geol. Assoc. 1869, "Pal. Biv. Entom.," pp. 8, 10, and 13, figs. I. and II.

Primitia simplex is the relatively short-backed and *P. mundula* the long-backed of the two well-known and most common of the Silurian forms of minute Ostracods.

Fig. 1.



Fig. 2.

Fig. 1.—Outline of *Primitia simplex*.Fig. 2.—Outline of *Primitia mundula*.

Both magnified 8 diameters.

Pl. XVI. fig. 1 (on no. 15 specimen) is an internal cast, oblong, with marginal rim (broken) and a neat sulcus, without thickened edges. The matrix is a ferruginous hard shale, with small gasteropods (obscure) and some plant-remains.

Fig. 2 (on no. 5) is a very neat valve, nearly semicircular along the free margins, with a narrow and weak sulcus, and ornamented with a delicate reticulation (fig. 2 *b*).

Fig. 4 (specimen no. 22) is a neat suboblong cast of *P. mundula*, but with the sulcus more forward, and less developed at its edges, than in the typical form. Other *Primitie* of somewhat similar pattern occur with it, also small gasteropods and plant-remains.

Fig. 5 (specimen no. 10) is a short oblong variety of *P. mundula* with well-developed sulcus (partly damaged) and an extremely delicate reticulate ornament, visible on some part of the shell. With plant-remains.

Fig. 6 (specimen no. 18) is a typical *P. mundula*, rather fuller in the ventral curve than fig. 29 *a*, pl. vi. 1855, and with feeble tubercles at the sides of the sulcus. The reticulate ornament of the valve's surface is shown in fig. 6 *b*. Many other simple *Primitie* accompany it, also fish-remains.

Fig. 7 (specimen no. 12). This cast does not differ much in shape from figs. 1, 2, 4, and 6, except in the fuller outline and extent of the posterior moiety; but the sulcus is more forward and its front edge is modified into a short swelling, going off, with a sinuous margin, into an antero-dorsal depression. This condition is possibly shown to a slight extent in fig. 6 *a*; and, if so, the gradation to *P. mundula* is sufficiently strong to prevent us giving fig. 7 a

separate name of any kind. There is also a faint depression behind and parallel to the posterior edge of the sulcus; and this may faintly foreshadow the second (hinder) furrow in *Beyrichia*. As internal casts often show developments of local features different in degree from what are seen on the outside of the valves*, possibly the perfect valve of fig. 7 *a* would not differ much from fig. 6 *a*, allowing for the fact of their being valves of the two different sides, and one being of larger growth than the other.

Several other casts of ordinary small *Primitia* of the *mundula* type, together with small gasteropods and plant-remains, accompany fig. 7.

Fig. 8 (specimen no. 7) is a cast with a partial film of shell and an obscure trace of reticulate ornament. In shape it is much like figs. 4 and 6, but the sulcus is broad, deep, and curved, the curvature having its convexity in a direction opposite to that in fig. 3—that is, curving downwards and forwards, not downwards and backwards. Behind the sulcus there are two slight depressions, possibly homologous with the slight valley behind the posterior edge of the sulcus in fig. 7 *a*. If this be taken for granted, we are still within the real range of *P. mundula*, however much the sulcus be intensified. There is here no indication of the antero-dorsal depression visible in fig. 7 *a*.

Fig. 9 (in specimen no. 9, with fish-remains) is a crushed cast, with broken valve. Its special value is that we here see an example of the typical *P. mundula*, like fig. 29 *a*, pl. vi. 1855, referred to above.

2. *Primitia scaphoides*, sp. nov. (Pl. XVI. fig. 3.)

Pl XVI. fig. 3, shows a dark valve, straight on the back, obliquely and elliptically curved on the free margins, boldly curved behind, contracted in front, and with the hinge-line shorter than the valve. The sulcus is median and strong (being broad and deep), crescentic, with its posterior edge raised into two obscure close-set tubercles. The surface bears an indistinct punctation. There is some resemblance between this form and *P. semicordata*, Jones (*op. cit.* 1855, p. 172, pl. vi. fig. 21, and 1865, p. 417), but the latter is shorter and has the front, and not the hinder, edge of the sulcus raised into a little tubercle. It would be more like *P. Salteriæna*, J. (*ibid.* p. 172, pl. vi. fig. 20 †, and p. 417), were it

* See, for instance, Ann. & Mag. Nat. Hist. March 1869, pl. xiv. figs. 5 and 6; and Verworn, Zeitschr. d. g. Gesellsch. 1887, pl. iii. figs. 3 and 6.

† There is too much margin in this figure.

coarsely pitted, the furrow more forward, and the tubercle smaller.

There are other little black *Primitiæ* (some of them like fig. 1) on the specimen with fig. 3, in the piece of hard dark argillaceous limestone no. 17.

Fig. 3 differs from the other forms on the Plate by its relatively large median sulcus, with backward curve, and by its relatively long subelliptical outline.

Taking the relative position and proportion of the sulcus into consideration we may see that it is variable in the above-described *Primitiæ* in these respects:—

- Sulcus relatively large in figs. 3, 5, 8.
- „ „ small in figs. 1, 2, 4, 6, 7, 9.
- „ straight in figs. 1, 2, 4, 5, 6.
- „ curved in figs. 3, 7, 8, 9.
- „ placed forwards in figs. 1, 2, 4, 6, 7, 8, 9.
- „ „ nearly in the middle in fig. 5.
- „ „ quite in the middle in fig. 3.

With regard to outline, all the figures, except figs. 1 and 3, show high (broad) valves.

In figs. 7 *a* and 8, and perhaps in fig. 6, there is certainly a step towards the formation of a central lobe between the normal sulcus and a feeble parallel depression. But this looks more like an abortive attempt to produce a family feature than such a regular progression of growth as shown by M. Verworn's figures 1, 2, 3, 6, 5, 7, 9, 11, 4, 10, and perhaps 8.

II. *Upper-Silurian specimens from Cap Bon-Ami.*

Most of these Ostracods (Pl. XVII. figs. 1–9) retain their tests, though some (figs. 7 and 8) have only part of the valve. For the material see p. 374. Having been magnified only 10 (instead of 15) diameters, they look relatively smaller than those from Campbellton (see p. 375).

3. *Primitia mundula*, Jones, var. (Pl. XVII. fig. 1.)

In Pl. XVII., fig. 1 (from specimen no. 25) indicates the smallest of the *Primitiæ* found among the Ostracoda collected at Cap Bon-Ami; taken by itself it may be regarded as a narrow variety of *P. mundula*, Jones (Ann. & Mag. Nat. Hist. ser. 2, vol. xvi. pp. 90, 174, pl. vi. figs. 28 and 29, and noticed in subsequent papers).

It is almost the same as fig. 1 of Pl. XVI., but is not so full behind, being more nearly oblong, and it has the front edge of the sulcus more decidedly raised or thickened.

4. *Primitia æqualis*, Jones & Holl, young form.
(Pl. XVII. fig. 2.)

Fig. 2 (from specimen no. 30), larger and of a fuller shape than fig. 1, appears to have one edge of the sulcus raised and isolated as a pimple, and the other moiety of the valve is slightly rucked up; but, seen in another light, each side of the sulcus appears to end dorsally in a little pimple, so that in this view there are two little nearly equal knobs near the back at the ends of the curved boundary of the sulcus, thus feebly imitating *P. æqualis* (Ann. & Mag. Nat. Hist. ser. 5, vol. xvii. 1886, p. 411, pl. xiv. fig. 11). There is no published figure exactly like fig. 2, though *P. nana*, Jones (*op. cit.* ser. 2, vol. xvi. 1855, pl. vi. fig. 22), in some degree, and more especially the young form of *P. cornuta*, J. & H. (*op. cit.* May 1886, pl. xiv. fig. 13), have somewhat analogous features. Further, as the young of *P. cornuta* is to the adult, so probably the specimen under notice is to the adult form of *P. æqualis* (*ibid.* fig. 11), the pimple and ridge being near the dorsal edge and each other.

5. *Beyrichia Klædeni*, M'Coy, var. *acadica*, Jones.
(Pl. XVII. figs. 3-6, 8, 9.)

As explained further on, these seem to be referable to a variety of *B. Klædeni*, having a considerable variability of lobes and furrows, as is the case with the true *B. Klædeni*, but without the tuberculation of surface which is present in the analogous varieties (*B. clausa* &c.), and with a strong marginal rim in well-preserved individuals. So close an analogue to the Carboniferous *B. gigantea* is seen in fig. 3 that, keeping *B. Klædeni* as the type, it is possible that we shall have to regard *B. gigantea* not as a real species*, but as var. *gigantea* of *B. Klædeni*.

Thus also another Carboniferous recurrent form and of specific standing is seen in our fig. 7 of the same Plate (see p. 381).

Fig. 3 (from no. 27) has a decidedly Beyrichian aspect, and might pass for a variety of *B. Klædeni*, such as the

* Further research, however, among the numerous specimens from Glencartholm, Dumfriesshire, is indispensable before arriving at this conclusion.

varieties *clausa* &c. (Ann. & Mag. Nat. Hist. April 1886, pp. 354-356, pl. xii. figs. 8, 9, 10), in which the two main lobes do not taper off one within the other, but are thick below and more or less confluent. The nearest known form, however, is *Beyrichia gigantea*, J., K., & B. ('Monogr. Carbonif. Entom.,' Pal. Soc. 1874, pl. iv. fig. 27, and 1884, p. 88); the latter measures $4\frac{1}{2}$ millim., the former only $1\frac{7}{10}$ millim. There is also some resemblance between fig. 3 and *Beyrichia Jonesii*, Dawson (non Boll), from the Carboniferous Limestone of Nova Scotia ('Acadian Geology,' 3rd edit. 1878, p. 313, fig. 132); but in this figure the central lobe is much larger, and is surmounted by a small tubercle.

The specimen from Cap Bon-Ami is associated with *Murchisonia*, a brachiopod, and an obscure fish-bone.

In fig. 4 (no. 26) the confluence of the two great lobes is more complete than in any published variety of *B. Klædeni* except var. *scotica* (Ann. & Mag. Nat. Hist. 1886, pl. xii. fig. 10). The middle lobe loses to a great degree the isolation due to the lateral furrows, especially in front and below, and becomes rounded. These features are not those of *Klædenia Wilkensisiana**, to which species this valve has at first sight some resemblance.

Fig. 5 (from specimen no. 31) has the middle lobe more isolated and longer than it is in fig. 4, and the front lobe fades away downwards, somewhat like that feature in the typical *B. Klædeni*, but still more resembling, in this respect, *B. gigantea* above-mentioned.

In fig. 6, however, a larger individual (from no. 25), the ventral coalescence of the lobes is perfect, as in var. *tuberculata* (*ibid.* 1886, p. 354, pl. xii. fig. 8) and in *B. gigantea* (Carbonif. Monogr. 1874, pl. iv. fig. 28); but the middle lobe is narrower, longer, and more parallel-sided than in those and other allied varieties, and much more so than in *Klædenia*. Figs. 3-6 moreover show a broad marginal flange, which is not seen in the forms just referred to.

I have a fine example like fig. 6 in a piece of dark grey argillaceous limestone, with *Cucullæa*, from Cap Bon-Ami, given to me by Sir J. W. Dawson at Montreal in 1884.

In fig. 8 (from no. 28, with *Orthonota* and *Cucullælla*?), excepting the median furrow, which is not very strong, behind a weak middle lobe, the depressions of the valve merely give it an undulating surface, there being one broad curved hollow on the hinder moiety separate from the flattish mar-

* See Ann. & Mag. Nat. Hist. ser. 6, vol. i. 1888, pp. 398 and 399, for remarks on this genus and some of its known species.

gin and a very shallow valley more forward. This is a very weak Beyrichian form.

Fig. 9 (also from no. 28) presents a large hinder (gigot) lobe, an ovate, isolated, middle lobe, and a divided anterior lobe, the upper portion of which is feeble, but the lower part is swollen, being hypertrophied, as is usual with many *Beyrichia* (see Ann. & Mag. Nat. Hist. ser. 5, vol. xvii. 1886, pp. 339-343). Another such individual is present in specimen no. 24 associated with *Orthonota* and *Cucullella*?

The absence of real differences (of essential value) in the series of six Beyrichian forms described above allows of their being referred to *B. Klædeni* as so many subvarietal individuals falling into one varietal group. Not one of them is exactly the same as the type of the species, nor do they take on what are regarded as the essential characters of any other species as at present known.

6. *Beyrichia arcuata* (Bean).
(Pl. XVII. figs. 7 a, 7 b, 7 c.)

Beyrichia arcuata, Jones and Kirkby, Geol. Mag. October 1886, p. 438, pl. xii. figs. 12-14.

Fig. 7 (from specimen no. 32) has a short, curved, anterior* furrow, and a deep, straight, median sulcus, with a distinct, though slight, lobe between them.

The geological persistency of this form (fig. 7) is shown by the similarity of some Carboniferous Ostracoda to our figure. *Beyrichiopsis simplex*, J. & K. (Geol. Mag. dec. 3, vol. iii. p. 437, pl. xii. fig. 4), is near to it, but has a shorter median and weaker anterior sulcus. *Beyrichia cratigera*, Brady (*ibid.* fig. 7), approaches it, and *B. arcuata* (Bean) (*ibid.* fig. 13) still more nearly. Their passage into the common three-lobed *Beyrichia* is illustrated by figs. 8-10, *ibid.*, also by some figures in pl. viii. Ann. & Mag. Nat. Hist. ser. 5, vol. xviii. 1886.

This Upper-Silurian Ostracode, then, is a *Beyrichia* different from those of the *B. Klædeni* type, and plentiful enough afterwards in Carboniferous times, when the representatives of the latter were rare, though of large size (*B. gigantea*).

In the Coal-measures *B. arcuata* is usually accompanied by plant-remains, together with *Anthracosia* and such-like shells and other fossils not of decidedly marine types; in the Gannister-coal series, however, it occurs with *Goniatites*, and Mr. Kirkby believes that *B. arcuata* is not truly a fresh-

* Judging from its position in analogous species.

water form, but rather an old marine form that has acquired estuarine habits by force of circumstances. Its existence in these Pre-Carboniferous marine strata at Cap Bon-Ami supports this view of its history.

Note.—For an account of fig. 11, also from Cap Bon-Ami, see further on, p. 383.

Remarks as to Relationship.

Herr M. Verworn, of Berlin, has already shown us, in his memoir on the "Developmental History of the *Beyrichia*" (Zeitschr. deutsch. geol. Gesellsch. 1887, pp. 27–31, with pl. iii.), that his *Beyrichia primitiva*, obtained as a series of young and adult forms in a Silurian limestone from the Drift at Rixdorf, near Berlin, is a *Primitia* when small and young, and becomes more and more Beyrichian with age, until it becomes identical with, or at least very closely approaches, *Beyrichia Salteriana*, the presence of the crenulated marginal flange in the latter being the chief distinction. If identical, the species would stand by the latter name.

Mr. C. D. Walcott also, in his memoir on the "Palæontology of the Eureka District," U. S. Geol. Survey, 4to, Washington, 1884, has indicated that his Devonian *Beyrichia* (*Primitia*) *occidentalis* (p. 204, pl. xvii. figs. 4 and 4a) begins as a *Primitia* and becomes a *Beyrichia* when adult.

At first glance the group of Ostracoda from Dalhousie (Pl. XVII. figs. 1–9) seemed to present another example of passage from *Primitia* to *Beyrichia*; but after very careful consideration I feel bound to confine my conclusions to the following:—(1) The probably close alliance by family ties, though not in this case by direct descent, of the two small *Primitiæ* (figs. 1 and 2), inasmuch as a progressive development of the edge of the sulcus in fig. 1 might lead to *P. strangulata*, *P. bicornis*, and others, whilst the tubercles in fig. 2 lead rather to *Bollia* and possibly to *Strepula*.

(2) Though the sulcus of *Primitia* may represent the main furrow of *Beyrichia*, yet the tubercles, sometimes single (on one or the other side of the sulcus), sometimes double (one on each side of the sulcus), are too uncertain to be regarded as homologues of the middle lobe of *Beyrichia*. In this respect therefore there is a gap in the relationship.

In 1860 M. d'Eichwald remarked ('Lethæa Rossica,' vol. i. livr. 7, p. 1347), after noticing the apparent relationship of the two variable species *Beyrichia tuberculata* (Klöden) and

B. Klædeni, M'Coy, that "*B. Wilkensis*, Jones, [*Primitia*] *complicata*, Salter, [*P.*] *strangulata*, Salter, [*P.*] *obliquejugata*, Schmidt, might be only varieties of *B. Klædeni* due to age"—the more or less elongate, simple, or divided forms of the main lobes, and the obliteration of the central boss, leaving only two ridges, constituting the differences. This is by far too sweeping a conclusion, ignoring the probable physiological value of the various soft parts and limbs covered by or occupying different parts of the valves, and fitted for differently constructed valves. That there are zoological relationships among the Ostracoda, as among both lower and higher animals, no one can doubt; but until we can define the evidence thereof as clearly as M. Verworm has defined the stages of his *Beyrichia primitiva* the present arrangements had better remain, so as to avoid confusion.

7. *Isochilina labrosa*, sp. nov.

(Pl. XVII. fig. 11, and woodcuts, figs. 3 and 4.)

Besides true *Leperditia* among the Palæozoic Ostracoda we not unfrequently find forms that approach them in shape and sometimes in relative size, but without having some of the true characteristics, such as are defined in the Ann. & Mag. Nat. Hist. November 1881, pp. 334, 335. It is to be noted, however, that such a *Leperditia* as var. *nana* of *L. canadensis* (vel *fabulites*), *op. cit.* April 1858, pl. ix. fig. 12, is destitute of external structural marks; and so are some Carboniferous *Leperditia* (*op. cit.* May 1865, pl. xx. and October 1886, pl. vii.).

My friend Mr. J. W. Kirkby agrees with me in stating that we have not seen the eye-spot or the muscle-spot in *Leperditia Youngiana*, *compressa*, *parallela*, *obesa*, and some other Carboniferous species. In *Leperditia Okeni* and *scotoburdigalensis* these features are rarely visible. We find also that the ventral overlap is not great in *Leperditia Youngiana* and *Armstrongiana* and is often weak in *L. scotoburdigalensis*. Not unfrequently it varies in development in individuals, the larger and more swollen forms having generally most overlap.

In *Leperditia* forms where the eye-spot or muscle-spot or both are present, but no ventral overlap, the genus *Isochilina* is recognized.

The specimen before us (Cap Bon-Ami, no. 3), fig. 11, is less exactly *Leperditia* than fig. 10 of the same Plate, being nearly oblong, but rounded on the free margins. It is very similar in outline to *Leperditia canadensis*, var. *labrosa*, J.

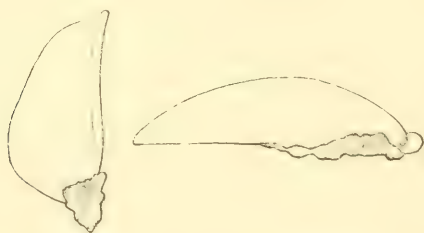
(Ann. & Mag. Nat. Hist. April 1858, p. 245, pl. ix. fig. 3), which, however, has the eye-spot and ventral overlap.

It seems not to have been thickened on the ventral margin nor to have overlapped there. No external structural marks are visible, but they may have been obliterated by fossilization, for the surface of the valve is roughened by minute accretions. The ends have broad rims, and so might the ventral margin have also been flanged, but the convexity of the ventral region overhangs, and the matrix hides it, if at all preserved.

In greenish-grey calcareous shale like that of other specimens from Cap Bon-Ami.

Fig. 3.

Fig. 4.



Figs. 3 and 4.—*Isochilina labrosa*, nov., magnified 10 diameters.
3. Front end view. 4. Ventral view.

[See Plate XVII. fig. 11.]

III. *Specimen from Manitoba.*

8. *Aparchites** *Whiteavesii*.

(Pl. XVII. fig. 10, and woodcuts, figs. 5 and 6.)

Other Ostracoda than those mentioned above, at p. 383, somewhat, but not quite, Leperditian in outline and contour, the dorsal angles being nearly or quite absent, are generally much smaller than the above-mentioned forms, and are without either ocular or muscular spot, and have no overlap on the ventral margin, though sometimes thickened there. Some such Ostracods, but of relatively large size, were described and figured in the Ann. & Mag. Nat. Hist. ser. 3, vol. xvi. 1865, pl. xiii. figs. 7, 10, 12-14, and ser. 4, vol. ii. 1868, pl. vii. figs. 1-4, as *Primitiæ*; and *P. solvensis* (*op. cit.*

* From ἀπαρχή, *primitia*.

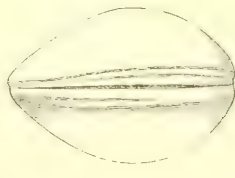
February 1856, pl. vii. fig. 16) and *P. muta* (*op. cit.* ser. 3, vol. ii. 1858, pl. ix. fig. 3) were added to the group because of the existence of such passage-forms (with obsolete sulci) as *P. Beyrichiana* and *pusilla*, J. & H., connecting them with the true *Primitia*. To these non-sulcate forms may be added *P. lenticularis*, J. & H., 1869, *P. Sanctojohannesiana*, *Lloydiana*, and *Milneana*, Jones, Ann. & Mag. Nat. Hist. November 1881, pl. xx. figs. 1-3; and to the passage-forms, var. *breviata* of the sulcate *P. valida*, J. & H., 1886: *P. cylindrica* (Holl) and *P. minuta* (Eichwald) possibly also belong to this non-sulcate group.

Fig. 10 and woodcuts, figs. 5 and 6 (specimen no. 2 of the whole series), illustrate a subglobular Leperditioïd Ostracod with strong dorsal angles fore and aft, and a steep postero-dorsal and more gentle antero-dorsal slope, the former falling into a bolder curve than the latter; and with the ventral outline almost semicircular. The ventral and end margins of the united valves are thick and bevelled inwards and slightly fluted there (see woodcuts, figs. 5 and 6). This character approaches that shown by fig. 1c in pl. vii., Ann. & Mag. Nat. Hist. July 1868, in a much less Leperditioïd carapace, which we referred to the *smooth* or non-sulcate *Primitia* (*P. McCoyii*, J. & H.). As it has not been figured for *Isochilina*, and is very distinct from the ventral edge of *Leperditia*, it may still be regarded as characteristic of the non-sulcate Primitian group here indicated, and which I take this opportunity of defining as a generic group separable from *Primitia* (though there are some passage-forms) as APARCHITES.

Fig. 5.



Fig. 6.



Figs. 5 and 6.—*Aparchites Whiteavesii*, nov., magnified 10 diameters.

5. Front end view. 6. Ventral view.

[See Plate XVII. fig. 10.]

In its outline the individual under notice, from Manitoba, is shorter and rounder than *Leperditia rotundata*, Walcott (Palæont. Eureka &c., 1884, p. 206, pl. xvi. fig. 5), and in

shape much more closely resembles *L. suborbiculata* (Münster), Ann. & Mag. Nat. Hist. May 1865, p. 407, pl. xx. fig. 7. The shell is superficially roughened from the effects of exposure.

The specimen consists of white limestone, and in this respect resembles the *Leperditia Billingsii**, J. (Ann. & Mag. Nat. Hist. ser. 5, vol. viii. 1881, p. 345, pl. xx. fig. 9), from Lower-Silurian strata near Lake Winnipeg.

The little fossil before us is from "the parish of St. Andrew, Manitoba, in the valley of the Red River, in rock of about the age of the Utica Slate or upper part of the Trenton Formation."

EXPLANATION OF THE PLATES.

PLATE XVI.

[All the figures are magnified 15 diam. except figs. 2 *b* and 6 *b*.]

Fig. 1. *Primitia mundula*, J., var. Left valve; a cast.

Fig. 2. The same, var. *a*, right valve; *b*, ornament of the valve, $\times 75$ diam.

Fig. 3. *Primitia scaphoides*, sp. nov. Right valve.

Fig. 4. *Primitia mundula*, J., var. *a*, right valve; *b*, edge view; *c*, end view.

Fig. 5. The same, var. *a*, right valve; *b*, edge view; *c*, end view.

Fig. 6. *Primitia mundula*, J. *a*, right valve; *b*, ornament, $\times 75$ diam.

Fig. 7. The same, var. *a*, left valve, cast; *b*, edge view; *c*, end view.

Fig. 8. *Primitia mundula*, J., var. Left valve, cast, with a small film of shell.

Fig. 9. *Primitia mundula*, J. Right valve, crushed cast, with parts of the shell.

[Figs 1-9 from Campbellton, New Brunswick.]

PLATE XVII.

[All the figures are magnified 10 diam.]

Fig. 1. *Primitia mundula*, J., var. Left valve.

Fig. 2. *Primitia æqualis*, J. & H. Right valve, young.

Fig. 3. *Beyrichia Klædeni*, McCoy, var. *acadica*, nov. Left valve.

Fig. 4. The same. *a*, left valve; *b*, dorsal edge view; *c*, front view.

Fig. 5. The same. Left valve.

Fig. 6. The same. *a*, left valve; *b*, ventral edge view; *c*, posterior view.

Fig. 7. *Beyrichia arcuata* (Bean). *a*, right valve (cast retaining some of the shell); *b*, dorsal edge view; *c*, front view.

* Possibly this may belong to *Aparchites* also.

- Fig. 8. *Beyrichia Kluedeni*, McCoy, var. *acadica*, nov. Left valve (cast, retaining some of the shell).
 Fig. 9. The same. *a*, left valve, with hypertrophied antero-ventral lobe; *b*, dorsal edge view; *c*, anterior aspect.
 Fig. 10. *Aparchites Whiteavesii*, nov. Carapace, showing the left valve. (See also the woodcuts, figs. 5 and 6.)
 Fig. 11. *Isochilina labrosa*, nov. Right valve. (See also the woodcuts, figs. 3 and 4.)

[Figs. 1-9 and 11 from Cap Bon-Ami, New Brunswick;
 fig. 10 from Manitoba.]

XLV.—On new *Lamiide* Coleoptera in the British-Museum Collection. By C. J. GAHAN, M.A., Assistant, Zoological Department, British Museum.

THE species here described belong to the groups Colobotheides, Amphionychides, and Aerenicides of Lacordaire and include some of the finest species of those groups. They are all from South America and the West-Indian islands, and were for the most part contained in the collections of Chevrolat and Dejean. Where practicable I have retained the manuscript names used by these authors.

Colobothea signativentris (Chevr. MS.), n. sp.

C. signatipenni persimilis, sed differt prothoracis lateribus paullo pone medium tuberculatis, et macula submediana lutea (elytrorum) postice in forma vittae continuata.

Long. 14-18 mm. ♂.

Hab. Bahia.

Robust; with a short greyish-brown pubescence above. Prothorax with a few scattered yellowish points, the disk with a median carina, which is strongly raised posteriorly, and with a feebly raised, somewhat elongated tubercle on each side of the middle, the sides each with a distinct tubercle a little behind the middle. Elytra broad between the shoulders, with the latter prominent, and thence gradually narrowed towards the apex; each with three velvety black spots along the disk and with an irregular luteous vitta beginning at the postero-lateral border of the first velvety spot, expanding between this and the second velvety spot and thence continued along the side of the lateral carina up to the apex. Apices emarginate, with the outer angles spinose. Body

underneath with a brownish pubescence; abdomen with a russet-brown pubescence at the sides, with a band along the middle of each of the last four segments black and somewhat velvety, and with a large and distinct velvety black spot on each side of the basal segment. Anterior tarsus (male) dilated and rather sparsely fringed with brownish hairs, with the first joint not much longer than the second. Antennæ with a greyish-brown close pubescence, and with the four basal joints sparsely setose underneath, with the setæ more thickly aggregated towards the apex of the scape.

This species so closely resembles *C. signatipennis*, Lamere, that it might at first sight be mistaken for it. The chief differences are pointed out above. If M. Lamere's species is the true *signatipennis* of Dejean, as I have no doubt it is, his description, so far as it applies to the abdomen, must be slightly amended. The middle of the abdomen is more or less velvety (not denuded), there is a large and distinct velvety black spot on each side of the basal segment, and there is a much smaller, somewhat elongated, velvety black spot at each side of the apical segment, and sometimes also a very small spot at each of the antero-lateral angles of the intermediate segments. In *C. signativentris*, excepting the large basal spots, there are no spots on the sides of the abdomen; but in this respect it may be liable to variation.

Colobothea elongata (Chevr. MS.), n. sp.

Nigra; capite antice fulvo-cinereo trivittato: capite et prothorace supra vittis duabus fulvo-cinereis, postice divergentibus, lateraliter utrinque univittatis: clytris fulvo-cinereo pubescentibus, nigromaculatis, fascia lata subapicali nigra, apicibus late truncatis, albo-marginatis, angulis externis spinosis; antennis nigris, articulis sexto et undecimo albis.

Long. 15-23 mm.

Hab. Cayenne.

Black, with three tawny ashy vittæ on the front of the head, the median vitta continued on to the vertex and there dividing into two strongly diverging vittæ, which are continuous with the two dorsal vittæ of the prothorax; with a single nearly straight whitish vitta on each side extending from the side of the head, below the eye, along the thorax as far as the abdomen. Scutellum black, somewhat ashy in the middle. Elytra a little broader at the base than the prothorax, gradually and slightly narrowed posteriorly, with the shoulders slightly oblique, with a tawny ashy pubescence, with numerous small black spots, most of which have a single

puncture, with a larger spot on each towards the apex, and with a broad subapical black fascia narrowly interrupted at the suture; the apices margined with white, broadly truncate, with the outer angles spined. Thorax grey in the middle underneath; sides of the abdomen with a whitish pubescence spotted with black. Legs black, femora varied with grey. Antennæ black, with the sixth joint towards its base and the eleventh at its middle whitish pubescent.

Male.—Fore tarsus broadly dilated, with the first joint nearly as long as the two succeeding joints taken together; first joint of the middle and hind tarsi almost as long as the three succeeding joints.

Female.—First joint of all the tarsi about as long as the two succeeding joints.

Colobothea Brullei (Dej. MS.), n. sp.

♂. Nigra; capite fronte albo trilineato, supra unilineato, lateraliter utrinque bilineato; prothorace lineis octo albescens; elytris cinereo-pubescentibus, nigro-maculatis, fascia lata subapicali nigra, apicibus late truncatis, angulis externis spinosis; pedibus nigris, griseo-annulatis, tarsis anticis valde dilatatis et late fimbriatis; antennis nigris, articulo sexto ad apicem noduloso.

Long. 24 mm.

Hab. Santa Cruz, Nauta.

Black; head with three white lines in front, the median line continued to the thorax. Prothorax with eight whitish lines, one on each side above the coxa, the remaining six visible from above, with the two most external on each side continued on to the sides of the head. Scutellum black. Elytra with the shoulders prominent in an upward direction, not much broader at the base than the thorax, with an ashy-white pubescence which is interrupted by numerous small, round, black spots, each having a setigerous puncture at its centre, with one or two larger fasciate spots on each, and a broad, subapical, black fascia, scarcely interrupted at the suture; the apices narrowly margined with white, broadly truncate, with the outer angles spined. Body underneath black, with the sides spotted with white. Anterior legs longer than the intermediate or posterior, with their tarsi dilated and broadly fringed with black hairs, and their first joint as long as the three succeeding joints; the first joint of the posterior tarsi about equal in length to the two succeeding joints.

Antennæ black, with a small notch at the apex of the sixth joint. (A nodule of the same kind exists at the apex of the

seventh joint in the male of an allied species, which I have little doubt is the *C. octolineata* of Bates, though that author makes no mention of the character.)

Three male specimens in the collection. In the specimen from Nauta the ashy pubescence of the elytra is more interrupted and appears as a mere reticulation.

Colobothea amæna (Chevr. MS.), n. sp.

Nigra; capitis fronte niveo trilineata, vertice lineis duabus antice conjunctis, postice late divergentibus; prothorace supra utrinque niveo bilineato; elytris disco maculis sex niveis.

Long. ♂ 23, ♀ 14-16 mm.

Hab. Bahia.

Dull black; head with three white lines in front, the median line at the vertex dividing into two, which diverge widely on the occiput. The disk of the prothorax with two white lines on each side, which are united together at the base and apex; each side of the prothorax with a supracoxal white vitta, which is continued along the side of the breast. Elytra with the shoulders very oblique, forming an almost continuous curve with the sides of the prothorax, gradually narrowed posteriorly, with the apices broadly truncated and the outer angles spined, with, on the disk of each, three snow-white spots—one near the base, oblong, the second at the middle also oblong, the third towards the apex nearly square; with a narrow white border at the apex and with a small white spot on the deflexed side of each elytron anteriorly. Body underneath black, with the sides of the breast and of the three intermediate abdominal segments white. Legs black, femora somewhat ringed with grey; the first joint of the anterior tarsus as long as the two succeeding joints taken together; the first joint of the middle and posterior tarsi as long as the three succeeding joints: the anterior tarsus of the male dilated and thickly fringed with black hairs. Antennæ wholly black.

This neat species, of which there are three specimens in the collection, is easily distinguished from *C. cassandra* (which it somewhat resembles in markings) by the extreme obliquity of the shoulders.

Colobothea socia, n. sp.

C. amænæ similis, sed differt humeris elytrorum minus obliquis, articulo tarsorum primo brevior; prothorace supra utrinque late univittato, maculis elytrorum majoribus.

Long. 18-21 mm.

Hab. Brazil.

Differs from the last species by the more prominent shoulders of the elytra, though these are still cut away somewhat obliquely, and by the relatively shorter first joint of the tarsi. The vittæ on the vertex are broader; there is a single broad vitta on each side of the thorax above instead of two (in one of the three specimens each vitta is divided by an incomplete narrow black line); the spots on the elytra are broader and more irregular in form.

This species differs from *C. cassandra* by the less prominent shoulders, by the Λ -forming vittæ on the vertex of the head, and the absence of the oblique fascia on the side of the head, which in *cassandra* is continuous with the dorso-lateral thoracic vitta.

Colobothea discicollis (Dej. Cat.), n. sp.

Nigra; prothorace dorso utrinque luteo univittato, et in medio inter vittas lato nigro-velutino, lateribus nigris, nitidis, singulo vitta supracoxali lutea; elytris postice vix attenuatis, humeris nec prominulis, luteo-pubescentibus, nigro-maculatis, fascia subapicali nigra; apicibus albo-marginatis, late truncatis, angulis externis spinosis.

Long. ♂ 19 mm.

Hab. Bahia.

Prothorax with a rather broad luteous vitta on each side above, each vitta continued on to the head in front, and, as a less well-defined vitta, for some distance along the middle of each elytron behind; the disk of the prothorax between the vittæ velvety black, the sides each with a supracoxal luteous vitta. Elytra scarcely narrowed posteriorly; with the shoulders extremely oblique and not prominent, so that the sides of the elytra form with the sides of the prothorax a continuous curve; with a luteous pubescence, which, except where it forms the basal vittæ, is much interrupted by larger and smaller black spots; with a subapical black fascia. Sides of the body underneath with a luteous pubescence, which on the posterior abdominal segments is restricted to a few spots. Antennæ black, the intermediate joints somewhat grey at their bases.

Two specimens in the collection.

Carneades vittata, n. sp.

Nigra; capitis fronte albo trivittata, vertice univittato; prothorace vittis quinque albis vel flavis, quarum una dorsali; elytris nigris,

lateraliter carinatis, singulo in medio prope basin leviter cristato, sutura, margine apicali, fasciis maculisque nonnullis, albis vel flavis; corpore subtus utrinque albo vittato, sterno in medio griseo-vel brunneo-pubescente.

Long. 19 mm.

Hab. Cuença, ♂; Nauta, ♀.

Black, with a dark brown somewhat squamous pubescence; the head with three whitish lines in front, one on the vertex continuous with the median thoracic vitta, and two spots on each side continuous with the two vittæ on each side of the prothorax; of these the supracoxal vitta is broader than the one higher up and is continuous with a rather broad stripe extending along the side of the breast and abdomen. Scutellum black, with a whitish line or spot in the middle. Elytra with a short and feebly raised ridge on the middle of each near the base, the ridge surmounted by one or two rows of granulated setigerous punctures; with an obtuse carina setting out from each of the prominent shoulders, extending inwards in an oblique and somewhat curved manner, and ending at about the posterior third of the elytron; with a more acute carina beginning behind and below the humeral prominence and passing backwards towards the outer apical spine, but without reaching the latter; these two carinæ enclosing a sloping and somewhat hollowed-out space; with a white sutural vitta branching outwards at the apex and giving off a short transverse branch on each side at the middle, with some small whitish spots on the disk anteriorly, with two spots on each side near the middle, and a short longitudinal spot on the sloping space of each towards the apex. Legs black; tarsi above grey, anterior tarsi of male dilated and fringed with short hairs, with the first joint scarcely longer than the second, the first joint of the posterior tarsus distinctly longer than the two succeeding joints taken together. Sterna in the female with a rather short greyish pubescence, in the male with a longer brownish pubescence and with a patch of longish hairs on each of the anterior and middle coxæ. Only five joints remain to the antennæ; these are black, with a distinct white pubescent patch on the outer side at the base of the fourth joint; the scape is gradually thickened from before the middle up to the apex.

The two specimens here placed together differ slightly in colour; the Cuença specimen, which is a male, has nearly white stripes and spots; in the Nauta specimen, a female, these are pale yellow.

Carneades bicincta, n. sp.

Nigra; capitis fronte griseo trivittata; prothorace fulvo-cinereo pubescente; elytris nigris cum fasciis duabus transversis (una submediana, altera versus apicem) et maculis parvis dispersis fulvo-cinereis; antennis nigris, articulis a tertio ad sextum basi griseis.

Long. ♂ 19, ♀ 13 mm.

Hab. Guadeloupe.

Black; head with three indistinct tawny-ashy vittæ on the front, the median vitta continued on to the vertex. Prothorax with a tawny or ashy pubescence, interrupted on the anterior and posterior borders by small black spots. Elytra broad and nearly straight at the base, with prominent shoulders and devoid of lateral carinæ, with two complete tawny or ashy transverse bands, one just in front of the middle, the other not far from the apex, and with some small scattered tawny spots chiefly restricted to the basal part, this part also sparsely punctured; the apices broadly truncate, with the sutural angles very slightly produced, the outer angles strongly spined. Body underneath black; each side of the metathorax with an oblique tawny patch continuous with the submedian elytral band; the posterior border of the first and the sides of the three following abdominal segments with a tawny pubescence. Legs black and somewhat glossy, with the first joint of the tarsi grey above; the middle and posterior legs of the male subequal, distinctly longer than the anterior, the tarsi of the latter dilated and fringed with hairs, with the first joint about equal in length to the succeeding joint; the first joint of the posterior tarsus scarcely as long as the two succeeding joints taken together. Antennæ black, with the bases of the joints from the third to the sixth grey, with the scape gradually thickened towards the apex from about the middle of its length.

Two specimens in Dejean's collection, bearing the specific name which I have adopted.

Hilarolea croceicollis, n. sp.

Hemilophus croceicollis, Chevr. MS.

Capite et prothorace flavo-testaceis, croceo-pubescentibus, illo suppone oculos fusco, hoc basi nigro, lateraliter utrinque obtuse tuberculato, dorso leviter trituberculato; elytris nigris, dense punctatis, fusco-pubescentibus, apicibus oblique truncatis, angulis externis minute dentatis, internis acutis; corpore subtus pedibusque nigris, femoribus anticis fusco-testaceis; antennis nigris,

articulis a secundo basibus anguste flavo-testaceis, articulo tertio incrassato.

Long. 15, lat. 5 mm.

Hab. Bolivia.

Head and prothorax yellowish testaceous with a somewhat ochraceous pubescence; with the antennal tubercles and a spot on each side of the head behind the upper lobes of the eyes dark brown, with the base of the prothorax above and a spot on each side of the base below black, with three slightly raised smooth tubercles on the disk and an obtuse tubercle on each side. Elytra black, rather densely punctured, with a rather faint dark brown pubescence, with a single sharp carina on each side disappearing at some distance from the apex, with the apices broadly and obliquely truncate, prolonged more at the suture than at the sides, and with the outer angles minutely dentate.

The type of this species appears to be a female specimen. The antennæ are not quite so long as the body, the third joint, and the fourth less distinctly so, are thickened. The apex of the last ventral segment is somewhat angularly emarginate in the middle, with the sides obtusely rounded. In a second specimen, apparently a male, the antennæ are broken off from the third joint, which is thickened. The apical ventral segment is narrower and is more strongly emarginate in the middle.

The species resembles *Hilarolea tuberculicollis*, Guér., and, in spite of the thickness of the third joint of its antennæ, can scarcely be generically separated from it.

Hilarolea Lacordairei, n. sp.

Amphionycha Lacordairei, Dej. Cat. p. 378.

Nigra; prothorace lateribus rufo vittatis, valde et obtuse tuberculatis, dorso leviter trituberculato; elytris nigris, opacis, sat dense punctulatis, plaga magna communi discoidali et macula marginali utrinque albo-griseis, apicibus singulis late et obtuse rotundatis; corpore subtus pedibusque nigris, mesothoracis episternis rufo-pubescentibus; antennis nigris, corpore multo brevioribus.

Long. 18, lat. $5\frac{1}{2}$ mm.

Hab. Brazil.

Head black, with a somewhat brownish (probably faded) pubescence in front. Prothorax slightly constricted in front of and behind the lateral tubercles, these very distinct though obtuse, and each covered by the broad, slightly oblique, reddish pubescent vitta of each side; the disk with three feebly raised

smooth tubercles. Elytra straight at the base, with a sharp carina on each side which ceases abruptly at a short distance from the apex, with the apices broadly and obtusely rounded, with a large, common, discoidal, testaceous spot, which is covered with a close greyish-white pubescence, and with a similarly coloured spot on each side below the lateral carina. Legs and body underneath black, the latter with a faint greyish pubescence, the apical ventral segment with a rust-brown (apparently faded) pubescence. Antennæ black, scarcely three fourths the length of the body, with the joints (the scape excepted) rather slender and sparsely ciliate, with the third joint much longer than the fourth.

The single specimen, probably a female, I refer with doubt to the genus *Hilarolea*.

Calocosmus holosericeus (Chevr. MS.), n. sp.

Capite nigro, tenuiter griseo-sericeo pubescente; prothorace purpurascente testaceo et nigro vario, grosse et sparsim punctato; elytris nigris, tenuiter sericeo-pubescentibus, humeris prominulis, apice rotundatis; pectore medio, abdomine femoribusque flavo-testaceis; tibiis tarsisque et antennis nigris.

Long. 12 mm.

Hab. San Domingo.

Head black, sparsely punctured, with a faint greyish, somewhat silky pubescence, with the labrum somewhat yellowish. Prothorax feebly dilated at the sides in the middle, strongly and sparsely punctured, of a purplish-testaceous colour, which in parts is almost black. Elytra black, with a silky gloss, giving in certain lights feeble greyish reflexions, sparsely punctulate between the base and the middle, rounded at the apex. Antennæ black, first eight joints almost as long as the body. (The remaining joints in the single specimen are broken off.)

Calocosmus melanurus, n. sp.

Amphionycha melanura, Latreille, Dej. Cat. 3rd edit. p. 379.

Fulvus, tenuiter pubescens, elytrorum tertio apicali et antennis nigris, harum articulis intermediis basi angustissime fulvis; prothorace lateribus medio obtusissime tuberculatis; elytris sat dense punctulatis, humeris prominulis, apice rotundatis.

Long. ♂ 9-10, ♀ $12\frac{1}{2}$ - $13\frac{1}{2}$ mm.

Hab. St. Domingo.

Wholly fulvous, with the exception of about the apical

third of the elytra, the antennæ, and apex of the mandibles, which are black, and the tarsi, which are somewhat dark brown; with a faint greyish pubescence. Head and prothorax sparsely punctured, the elytra more minutely and densely punctured. Antennæ in the male a little longer than the body, in the female about three fourths the length of the body, with a variable number of joints very narrowly fulvous at their bases.

Calocosmus marginipennis (Chevr. MS.), n. sp.

Tenuiter pubescens; capite prothoraceque flavo-testaceis, illo pone oculos nigrescente; elytris purpurascento brunneis, sutura marginibusque lateralibus fere usque apicem flavo-testaceis, apice rotundatis; pectoris lateribus, abdomine tarsisque subfuscis; femoribus tibiisque flavo-testaceis; antennis subfuscis, articulo tertio scapo multo longiore.

Long. ♂ $10\frac{1}{2}$, ♀ 12 mm.

Hab. Jamaica.

Head with a few widely separated punctures, with a large patch behind each eye black or purplish brown. Prothorax very sparsely punctured, testaceous (in some specimens slightly brown at the sides), with the sides slightly expanded and rounded in the middle. Elytra minutely and rather thickly punctured, the punctures disappearing towards the apex, with the suture and lateral margins yellowish testaceous, the rest of the elytra purplish brown, rounded at the apex. The abdomen and sides of the breast somewhat purplish brown, the legs (tarsi excepted) and middle of the breast yellowish testaceous. Antennæ (in the female a little longer, in the male about a third longer than the body) with the third joint nearly twice as long as the scape, with the latter about equal in length to the fourth joint.

The extent to which the purplish-brown colour pervades the elytra is variable; in one or two specimens the elytra are brownish only towards the apex. The underside of the body varies also in this respect. Excepting *C. speciosus*, Chevr., I know of no species of the genus in which the third joint of the antennæ is relatively so long.

Amphionycha albomaculata (Dej. Cat. p. 379), n. sp.

Luteo-brunneo pubescens; capite supra maculis duabus albis; prothorace postice constricto, dorso antice gibboso, lateraliter utrinque albo-uniplagiato; elytris singulis maculis duabus magnis ovalibus abbis (una submediana, altera versus apicem), apicibus subrotundatis; corpore subtus lateraliter albo-maculato.

Long. 15, lat. 4 mm.

Hab. Brazil.

Head strongly retracted, broader than the prothorax, with a brownish pubescence, punctured in front, and with two pure white rounded spots above. Prothorax sparsely punctured above, constricted towards the base, gibbous anteriorly, the sides each with a large plagiote pure white spot touching the posterior but not reaching to the anterior margin, and with two small supracoxal white spots. Elytra with a brownish pubescence, each with a nearly straight lateral carina, and with two large oval white spots, one submedian, more in front of than behind the middle, the other about midway between this and the apex; the apices somewhat obliquely truncate or almost rounded. Body underneath luteous brown, with a spot on each side of the mid and hind breast and of each of the abdominal segments white. Legs luteous. Antennæ luteous brown.

Amphionycha nigrocincta, n. sp.

Capite nigro, fronte sparse punctata; prothorace supra viridi-albo pubescente, lateribus antice nigris, punctatis; elytris viridi-albo pubescentibus, cum fasciis duabus transversis, glabris (una basali, altera pone medium), et macula utrinque ad apicem, nigris; pedibus et articulis quatuor basalibus antennarum stramineis, articulis cæteris nigris.

Long. 12, lat. 4 mm.

Hab. Brazil.

Head black, sparsely punctured in front, with the labrum partly and the palpi wholly yellowish testaceous. Prothorax above with a close greenish-white pubescence, which extends downwards on to the sides towards the base. Elytra with a close greenish-white pubescence, with two naked transverse black fasciæ, one at the base, the other behind the middle, with the declivous sides between the fasciæ also naked and black, and with a black spot on each elytron at the apex; with a sinuate carina on each side; the apices somewhat rounded. Body underneath black, with a close whitish pubescence on the sides of the breast, and with a band of ashy pubescence on the hind part of each of the first four abdominal segments, the bands slightly interrupted in the middle. The legs and the four basal joints of the antennæ of a straw-yellow, the remaining joints of the antennæ black.

Amphionycha bicolor, n. sp.

Capite, thorace et tertia parte basali elytrorum flavo-testaceis; cætera parte elytrorum et abdomine nigris; femoribus omnibus

et tibiis anticis mediisque flavo-testaceis; antennis articulis quatuor basalibus testaceis, cæteris fuscis.

Long. 11 mm.

Hab. Ecuador.

Almost bare of pubescence; with the head, thorax, and a little more than the anterior third of the elytra yellowish testaceous; the abdomen and corresponding (or covering) portion of the elytra black and glossy, with a faint greyish pubescence posteriorly. Elytra rather closely punctured on the basal half, impunctate on the posterior half; with two carinae on each side, the lower extending further back than the upper; the apices sinuately truncate, with the outer angles dentate, the sutural angles acute. Legs yellowish testaceous, with the posterior tibiae and the first and fourth joints of each of the tarsi black, the intermediate joints of the tarsi reddish brown.

Amphionycha marginicollis, n. sp.

Brevis; capite nigro, griseo-mutante; prothorace testaceo, griseo-pubescente, dorso antice et postice nigro-marginato; elytris nigris, nitidis, antice punctatis, singulisque maculis tribus discoidalibus (una prope basin, una mediana, tertia prope apicem) et una laterali flavo-testaceis, apicibus conjunctim rotundatis; abdomine testaceo, griseo-albo pubescente; coxis testaceis, femoribus stramineis, tibiis nigro-fuscis; antennis nigro-fuscis, scapo extus, articulis quarto toto et tertio apice flavis.

Long. 8, lat. 3 mm.

Hab. Cayenne.

Head black, with a faint silvery-grey pubescence. Prothorax testaceous, with a pale grey pubescence, punctured; the disk with a naked border at the base and apex black and shiny. Elytra glabrous, black and shiny, with the basal half punctured, with a distinct sinuous carina on each side, each with four yellowish-testaceous spots, one near the base, two median, of which one is above, the other below the lateral carina, the fourth near the apex. The posterior spots with a pale greyish pubescence. Hind breast black; abdomen (except at the sides of the two basal segments) testaceous, with a greyish-white pubescence. Antennae black, with the scape on the underside, the fourth joint, and the apex of the third joint pale flavous; the ninth joint is reddish brown and the last two joints, which in the single specimen are broken off, are probably of the same colour.

This species is the *Amphionycha albiventris* of Dejean's Catalogue; but this name has been already used by Mr. Bates for another species.

Amphionycha procera (Chevr. MS.), n. sp.

Magna, griseo-pubescent; prothorace pube brevis margaritaceo-cana, dorso vitta mediana lata griseo-pubescente; elytris utrinque carina valde sinuata et ad medium evanescente, griseo-pubescentibus, cum plaga magna communi, antice et postice dentata, singulisque postice plagis duabus irregularibus, margaritaceis; pedibus antennisque griseo-pubescentibus.

Long. 22, lat. 7 mm.

Hab. South Brazil.

Head retracted, with a greyish pubescence, sparsely punctured in front. Prothorax slightly constricted towards the base; the sides with a very fine, close-set, pearl-grey pubescence, which extends on to the disk as far as the broad median dorsal vitta of grey pubescence, the latter margined by a reddish-brown naked line on each side. Elytra with a greyish pubescence, with a very large, common, angulate plaga of short and close-set pearl-grey pubescence, which extends from the scutellum to near the middle and from the carina of one side to that of the other, and with two similarly coloured irregular fasciæ or plagæ on each towards the apex. The plagæ margined by naked reddish-brown lines. Apices of the elytra rounded. Body underneath with a greyish pubescence, with a finer whitish pink-tinted pubescence on the sides of the breast. Legs and antennæ grey, the latter sparsely and shortly ciliate below.

Amphionycha? antiqua, n. sp.

Brunnescens, subnitida; capite inter antennis macula magna alba, occipite elevato; prothorace postice constricto, antice gibboso, dorso utrinque albo-plagiato; elytris sine carinis singulisque maculis tribus magnis, subovalibus, albis (una versus basin, secunda submediana, tertia versus apicem), apicibus rotundatis; pedibus antennisque brunnescentibus.

Long. 18, lat. 5 mm.

Hab. Brazil.

Brownish, somewhat glossy. Head retracted, with a large pubescent white spot between the antennal tubercles, and with the occiput raised. Prothorax sparsely punctured, posteriorly constricted, anteriorly gibbous, with a large plagiote white spot on each side above, each spot marked with a short transverse line towards its inner side a little before the middle of its length. Elytra brownish, subnitid, sparsely punctured on the basal half, each with three large, somewhat oval, pubescent white spots placed close to the suture—one near

the base, one submedian, rather behind than in front of the middle, the third towards the apex; the sides of the elytra destitute of carinæ, the apices rounded. Antennæ brownish, with the joints somewhat greyish at their bases, sparsely ciliate below, with the first and fourth joints subequal, each scarcely more than half as long as the third joint.

This species, of which there is but a single specimen in the collection, differs from all other recognized species of *Amphionycha* by the rounded sides of its elytra, which are devoid of carinæ. This character is met with in the allied West-Indian genus *Calocosmus*, but the remaining characters seem to me to unite the present species more closely with *Amphionycha* than with the latter genus.

Ærenica acutipennis (Chevr. MS.), n. sp.

Pube flavo-grisea omnino dense vestita; capite linea mediana impressa nigra; elytris apicibus acutis, singulis spina terminatis. Long. $18\frac{1}{2}$, lat. $4\frac{3}{4}$ mm.

Hab. Brazil.

Rather robust for the genus. Head, prothorax, elytra, and body underneath with a unicolorous dense yellowish-grey pubescence; the legs and antennæ with a darker grey pubescence, with the joints of the latter from the third somewhat fuscous towards their apices. Head with a median impressed naked line, which is more conspicuous towards the vertex. Antennæ sparsely pilose. Elytra with their apices acute, each terminated by a rather strong and sharp spine.

XLVI.—On the *Mollusca* collected by Mr. G. A. Ramage in the Lesser Antilles.—Report III.* By EDGAR A. SMITH.

THE collection which has recently arrived contains a few species of terrestrial *Mollusca* from Dominica and St. Lucia.

Those from Dominica are:—1. *Helix badia*, 2. *Bulimus multifasciatus*, 3. *Amphibulima patula*, 4. *Helicina rhodostoma*, 5. *H. fasciata*, 6. *H. platychila*.

As references to these species and their distribution have already been given in the previous Reports, it is unnecessary

* For Reports I. and II. see Ann. & Mag. Nat. Hist. 1888, vol. ii. pp. 227–234, 419, 420.

to repeat them here. The single specimen of *Helix* differs from those previously recorded, which were dark purple-brown. It is of a luteous tint, with a brown zone above and below the somewhat acute periphery; the penultimate and upper whorls are also dark brown. The *Bulimus* belongs to the same variety which is described in my second Report.

Two specimens which I regard as a variety of *Helicina fasciata* are pale at the apex, the rest of the upper surface being reddish and more or less freckled or reticulated with white, especially the last whorl. The lower surface is yellowish and the labrum bright yellow. In form and sculpture they are normal.

The three examples of *H. platychila* are unusually small, having an extreme diameter of 7 millimetres. They consist of five whorls as usual, are uniformly dirty whitish, in other respects agreeing with ordinary specimens.

The collection from St. Lucia contains only six species†, but of these four are new. This is not altogether surprising, for, so far as I can ascertain, the conchological fauna of the island has only been very casually investigated.

Until the year 1869 only two species had been recorded from this locality—*Helix orbiculata* and *Bulimus aulacostylus*—the latter and the four new species hereafter described being, so far as known at present, restricted to this island. Several of the other species occur also on one or more of the adjacent islands or even on the mainland of South America. Mr. Ralph Tate spent about two hours on St. Lucia in 1869, and was fortunate in collecting as many as twelve species; these were obtained in the neighbourhood of Castries, on the west side of the island. Mr. Ramage's specimens were all collected at "Fonds St. Jacques," the precise position of which I have been unable to discover.

As in previous Reports, I have appended a list of the known species, with references to some of the more important figures and their geographical range.

*1. *Helix (Dentellaria) orbiculata*, Férussac.

Helix (Helicogena) orbiculata, Férussac, Prodróm. p. 36. no. 86; id. Hist. nat. Moll. pl. xlvii. figs. 3, 4.

Helix orbiculata, Deshayes, Hist. nat. Moll. vol. i. p. 117; Pfeiffer, Conch.-Cab. p. 39. no. 424, pl. lxx. figs. 9, 10; Reeve, Conch. Icon. pl. lii. fig. 251; Drouët, Moll. terr. Guyane, p. 55; Tate, Ann. & Mag. Nat. Hist. 1869, vol. iv. p. 356; Mazé, Journ. de Conch. 1874, vol. xxii. p. 161, vol. xxxi. p. 10.

Hab. Forests of Cayenne and Guiana and Trinidad

† These are marked with an asterisk.

(*Férussac*); in gardens at Cayenne, also in the woods and other parts of Guiana (*Drouët*); Martinique, very abundant in all parts, especially in damp and shady places (*Mazé*); Guadeloupe, rare! (*Mazé*); St. Lucia (*Bland and Tate*).

The specimens from St. Lucia apparently do not differ from those occurring on the mainland in Guiana and present very little variation among themselves. Some have the spire rather more elevated than others and some slight difference in size is noticeable. The colour appears to be very constant and is well represented by the figures of Reeve and Pfeiffer. Young shells are deeply perforate and sharply keeled at the periphery.

*2. *Helix (Hadra) sanctæ-luciæ*.

Testa depressa, orbicularis, anguste perforata, tenuis, nitida, vinoso-cornea, ad peripheriam carinatum pallida aut virescens; anfractus 5, lente crescentes, superne convexiusculi, radiatim fortiter plicati, microscopice spiraliter striati; ultimus paulo supra medium carinatus, vix descendens, infra carinam leviter plicatus, striis incrementi aliisque concentricis tenuissimis sculptus; apertura lunata; peristoma vinoso-fuscum, anguste expansum et reflexum, supra umbilicum leviter dilatatum, marginibus callo tenuissimo junctis.

Diam. maj. 18 millim., min. $14\frac{1}{2}$; alt. $9\frac{1}{2}$.

This species is remarkable on account of the strongly plicate upper surface, which contrasts with the comparatively smooth base. The first two whorls forming the top of the spire are smooth and the plicæ gradually develop in thickness upon the remaining volutions. Upon the last whorl they are interrupted by the pale keel, and soon attenuate and become obsolete beneath it. The keel passes right round the whorl, but does not modify the regular curve of the labrum.

The foot of the animal is of a vinous tint and the mantle is conspicuously marbled with coal-black.

3. *Helix (Acanthinula) ierensis*, Guppy.

Helix ierensis, Guppy, Proc. Sci. Assoc. Trinidad, 1869, p. 242; Amer. J. Conch. vol. vi. p. 307, pl. xvii. fig. 4; Tate, Ann. & Mag. Nat. Hist. 1869, vol. iv. p. 356.

Hab. Trinidad (*Guppy*); Santa Lucia, "among rubbish of old walls and houses, Castries" (*Tate*).

4. *Helix*, n. sp.

Hab. Santa Lucia (*Tate*).

The existence of this species is merely casually referred to by Tate (Am. J. Conch. vol. v. p. 155).

*5. *Bulimus (Eurytus) aulacostylus*, Pfeiffer.

Bulimus aulacostylus, Pfeiffer, Proc. Zool. Soc. 1852, p. 59; Conch.-Cab. p. 114, pl. xxxv. figs. 5, 6; Monog. Hel. vol. iii. p. 316; Tate, Ann. & Mag. Nat. Hist. 1869, vol. iv. p. 356.

Bulimus lentiginosus, Redfield, Ann. Lyc. N. H. 1853, vol. vi. p. 14.

Hab. St. Lucia (Pfeiffer, Tate, Ramage); Trinidad and Demerara (Redfield, fide McMurray).

Tate (*l. c. supra*) states that this species is peculiar to the island of St. Lucia, but he does not mention the fact that it has been recorded from Trinidad and Demerara. However, it is not mentioned by Guppy in his list of the shells of Trinidad; and Bland (Ann. Lyc. N. H. New York, vol. vii. p. 361) remarks, "I am satisfied that the information afforded by the late Mr. McMurray as to the habitat (Trinidad and Demerara) of *B. aulacostylus* was incorrect." Until, therefore, its occurrence in those two localities receives confirmation it may be regarded as restricted to St. Lucia.

The largest specimen collected by Mr. Ramage is 43 millimetres in length, six longer than the type described by Pfeiffer.

*6. *Bulimus (Leptomerus) sanctæ-luciæ*.

Testa elongata, anguste rimata, tenuis, epidermide fusco-cornea, paulo nitida induta; anfractus 7, convexi, primi duo oblique tenuiter costulati, cæteri lineis incrementi obliquis aliisque spiralibus puncturatis et setigeris ornati, sutura simplice sed profunda sejuncti; ultimus inferne et labrum versus pallidior, circa medium zona angusta, pallida, minime conspicua, cinctus: apertura parva, albida, longit. totius circiter $\frac{2}{5}$ æquans; peristoma tenue, haud expansum, margine columellari late reflexo, rimam subobtegente.

Longit. 21 millim., lat. 9; apertura $8\frac{1}{2}$ longa, 5 lata.

This species is somewhat intermediate in form between *B. chrysalis*, Pfr., and *B. martinicensis*, Pfr. It is, however, well distinguished by the sculpture of the apical whorls and the pilose punctured striæ of the rest. The reflexion of the columella also is different.

7. *Bulimus (Leptomerus) tenuissimus*, Férussac.

Helix (Cochlogena) tenuissima, Férussac, Hist. Moll. pl. cxlii b. fig. 8.

Bulimus tenuissimus, Deshayes, *op. cit.* vol. ii. p. 72; Reeve, Conch.

Icon. pl. xlv. fig. 288; Pfeiffer, Conch.-Cab. no. 340, pl. lxiii. figs. 25, 26; Tate, Ann. & Mag. Nat. Hist. 1869, vol. iv. p. 356.

Hab. Brazil, Cayenne (*Deshayes*); Trinidad (*Guppy*); St. Lucia (*Tate*); "Angostura" (*Pfeiffer*).

This species is common at Rio Janeiro on garden walls, among plants (*Hidalgo*).

8. *Stenogyra caraccasensis*, Reeve.

Bulimus caraccasensis, Reeve, Conch. Icon. pl. lxxix. fig. 580; Tate, Ann. & Mag. Nat. Hist. 1869, vol. iv. p. 356.

Hab. "Caraccas, Orizaba, Vera Cruz (*Berendt*); Haiti (*Hjalmarson*); Panama (*Bland*)," fide *Pfeiffer*; St. Lucia (*Tate*); Grenada and Trinidad (*Guppy and Bland*).

9. *Stenogyra plicatella*, Guppy.

Stenogyra plicatella, Guppy, Ann. & Mag. Nat. Hist. 1868, vol. i. p. 438; Tate, *op. cit.* 1869, vol. iv. p. 356.

Hab. Trinidad and Grenada (*Guppy*); St. Lucia (*Tate*).

10. *Stenogyra coronata*, Guppy.

Stenogyra coronata, Guppy, *l. c. suprâ*, p. 439; Tate, *l. c.* p. 356.

Hab. Trinidad (*Guppy*); St. Lucia? (*Tate*).

11. *Stenogyra octona* (Chemnitz).

Hab. Dominica, Trinidad, and many other islands of the West Indies; St. Lucia (*Tate*).

12. *Leptinaria lamellata* (Pot. et Mich.).

Hab. St. Lucia (*Tate*).

For distribution and references see Ann. & Mag. Nat. Hist. 1888, vol. ii. p. 228.

13. *Succinea approximans*, Shuttleworth.

Succinea approximans, Shuttl. Bern. Mittheil. 1854, p. 147; Pfeiffer, Mon. Helic. vol. iv. p. 817.

Hab. St. Lucia (*Tate*); also Porto Rico, St. Thomas, Dominica, Grenada, and perhaps Guadeloupe.

14. *Cylindrella costata*, Guilding.

Cylindrella costata, Pfeiffer, Philippi's Abbild. vol. i. p. 183, pl. i. fig. 16, vol. ii. p. 52, pl. ii. fig. 8; Conch.-Cab. pl. v. figs. 4-6; H. & A. Adams, Gen. Moll. pl. lxxvi. fig. 7.

Hab. Barbados, St. Lucia (*Tate*).

*15. *Helicina Ramagei*.

Testa depresso conica, tenuicula, virenti-flavida, apicem versus rubescens, vel superne omnino rubescens, nitida, lineis longitudinalibus obliquis, *conferatissimis*, *microscopicis* ornata; anfractus $4\frac{1}{2}$, convexiusculi, striis incrementi tenuissimis sculpti, ultimus ad peripheriam rotundatus; apertura leviter obliqua; peristoma tenue, expansum, intus paulo a margine incrassatum, ad columellam angulatum, marginibus callo tenui, semicirculari, nitido, junctis. Operculum in medio leviter concavum, flavidum, marginem externum versus rufo-sanguineum.

Diam. maj. $13\frac{1}{2}$ millim., min. 11; alt. 9.

This is a thin glossy species devoid of sculpture, excepting the fine lines of growth. The excessively fine lineation is invisible to the naked eye and most conspicuous under the lens on the last whorl. The form is somewhat near that of *H. antillarum*, Sowerby.

*16. *Helicina roseolabrum*.

Testa parva, globoso-depressa, solidiuscula, subnitida, grisea vel roseo-grisea, interdum linea angusta rubra ad peripheriam cincta; anfractus $4\frac{1}{2}$, vix convexiusculi, striis incrementi obliquis, aliisque minutis oblique transversis sculpti, ultimus in medio acute rotundatus, antice levissime descendens; apertura parva, parum obliqua; peristoma tenue, anguste expansum, vix reflexum, roseo-rufum, marginibus callo tenui rufo junctis.

Diam. maj. 6 millim., min. 5; alt. $4\frac{1}{2}$.

Pfeiffer's figure of *H. Dysoni* (Conch.-Cab. pl. viii. fig. 27) will be a guide as to the form of this species. The coloured lip and basal callus and the small size are characters which well distinguish this from other species. Of the three specimens under examination two have the peripheral band, the other being of a uniform vinous-grey tint.

17. *Helicina plicatula*, Pfeiffer.

Helicina plicatula, Pfeiffer, Conch. Cab. p. 13, pl. viii. figs. 39-42; Sowerby, Thesaurus, vol. iii. pl. 268. figs. 79, 80.

Hab. Martinique; St. Lucia (*Tate*); Dominica (*Guppy*).

XLVII.—*On a new Species of Hæmaphysalis, C. L. Koch, imported into England by Syrrhaptes paradoxus.* By the Rev. O. PICKARD-CAMBRIDGE, M.A., F.R.S., &c.

Class ARACHNIDA.

Order ACARIDEA.

Fam. Ixodidæ.

Genus HÆMAPHYSALIS, C. L. Koch.

Hæmaphysalis peregrinus, sp. n.

Adult female, length 4 lines, breadth $2\frac{1}{2}$.

Cephalothorax, *palpi*, and *legs* bright red-brown.

Abdomen deep liver-coloured brown.

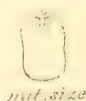
Cephalothorax oval, very finely punctuose and striated.

Palpi very short, terminal joint large and subtriangular.

Eyes absent.

Legs seven-jointed and furnished with a few short hairs.

An example of this Acarid, which appears to me to be undescribed, was received in the early summer of 1888 from Professor Newton, of Magdalen College, Cambridge, and another subsequently from Mr. John Cordeaux, of Great Cotes, Ulceby, Lincolnshire. Each of these examples had been taken from a specimen of *Syrrhaptes paradoxus* killed during the remarkable immigration of that bird into England in 1888.



XLVIII.—*The Staphylinidæ of Japan.*

By Dr. D. SHARP.

[Continued from p. 334.]

Subfam. OXYPORINÆ.

The occurrence of a considerable number of species of the isolated genus *Oxyporus* in Japan is another point of similarity of some importance between its fauna and that of North America.

Oxyporus niger, n. sp.

Niger, nitidus; tarsis testaceis; antennis basin versus et ad latera nigris; elytris disco irregulari, fortiter multipunctatis.
Long. 11 millim.

This is allied to *O. Mannerheimi*, Gyll., but is of larger size and has a longer thorax and more sculpture on the wing-cases; the antennæ too are different in colour, the basal joint being piceous, the next two yellow, the fourth piceous yellow, and the remainder black with the sides of each joint yellow.

Oyayama, in Kiushiu, 1st June, 1881; three specimens.

Oxyporus triangulum, n. sp.

Niger; elytris oblique testaceo-vittatis; tibiis ex parte majore tarsisque testaceis; antennis basin versus et ad latera rufis.
Long. 11 millim.

Allied to the European *O. maxillosus*, though different in colour, and in this respect more similar to the North-American *O. femoralis*, Gr. There is on the elytra a large triangular patch of black colour extending along the suture from the base to the apex, another large black mark at each outer angle, these latter two marks extending inwards and meeting at the suture, and each on the outside reaching to the shoulder; thus the yellow colour is limited to two quite separated oblique stripes, a character which distinguishes it from its Japanese and European congeners.

From the examples before me it appears that this insect is frequently found in an immature state, and then the characteristic coloration is not so conspicuous. The colour of the legs appears to be variable; in the most developed examples the femora are quite black and the tibiæ pallid yellow, except a small part of their length at the base and apex; but the tibiæ may become suffused with black, while, on the other hand, the femora are sometimes more dilute in colour, so as to be nearly or quite yellow.

Found on Oyama, Oyayama, and at the base of Fujisan.

Oxyporus japonicus, n. sp.

Niger: elytris pedibusque flavis, illis sutura maculaque ad angulum externum nigris; antennis piceis, articulis 5^o-10^m marginibus testaceis.
Long. 10-12 millim.

This is closely allied to *O. maxillosus*, but does not agree

in colour with any of the European or Siberian varieties I have seen of that species, moreover it has the elytra longer, so that I have little doubt it is distinct. The suture is black from the scutellum to the extremity, and the conspicuous black mark at the outer angle does not extend inwards to the suture, though along the deflexed sides it reaches in front nearly to the shoulder; the two striæ on the elytra are definite, but there are very few additional punctures. The hind body is entirely black; the legs, though yellow, have the tibiae infusate towards the extremity and frequently likewise at the base.

Mr. Lewis obtained a small series of examples; they are unfortunately in bad preservation. Occurs in South Yezo and has been taken in Kawatchi. This is the species referred to *O. angularis*, Gebl., in Trans. Ent. Soc. 1874, part i. p. 89.

Oxyporus maculiventris, n. sp.

Niger; antennis, palpis, elytris, pedibus abdominisque segmentis duobus basalibus marginibus flavis; elytris ad angulum exterio-rem oblique nigro-signatis.

Long. 8 millim.

This is the nearest of the Japanese species to the European *O. macillosus*, but it does not agree in colour with any of the varieties I have seen of the species mentioned; and as it differs also in the punctuation of the elytra, I have little doubt it is distinct. All the palpi and antennæ are clear yellow, the latter are very short. The thorax is very short. The elytra are bright yellow, even the suture being of that colour except just behind the scutellum; at the outer angle is a large black mark that extends inwards along the hind margin, but disappears before reaching its fellow of the opposite side; the hind body is jet-black, but the two basal segments have the lateral margins yellow in a very definite manner. The legs are clear yellow except the coxæ and trochanters. The elytra are considerably shorter than they are in *O. japonicus*; the two lines of serial punctures are very definite, and outside them there is a third series, in front divergent; between the serial punctures and the suture there are only a few other punctures.

A small series was obtained, but the locality was not noted.

Oxyporus parvus, n. sp.

Niger; elytris pedibusque flavis, illis ad latera latius oblique nigro-maculatis; antennis palpisque fusco-testaceis; abdominis seg-

mentis duobus basalibus marginibus flavo-maculatis; femoribus ad basin nigris; elytris punctis adjectis numerosis.

Long. 8-10 millim.

This differs from *O. maculiventris* not only in the colour of the antennæ and palpi, but also in other characters which, though not so conspicuous at first sight, are really more important. The thorax is longer and the elytra possess numerous irregularly placed punctures, amidst which the two lines of serial punctures are not very definite; the large black patch at the outer angle of the elytra extends inwards and meets its fellow of the opposite side; the femora are black at the base and the tibiæ a little infusate at the base and apex.

I have seen only two specimens.

Oxyporus germanus, n. sp.

Niger; palpis, pedibus, elytris abdominisque marginibus lateralibus pallide flavis; antennis rufis; elytris sutura anguste maculaque ad angulum externum nigris.

Long. 7-10 millim.

Very closely allied to the North-American *O. vittatus*, Grav., but differing in several minor points. The head is less elongate; the black colour of the suture of the elytra is not at all dilated in front; the terminal two segments of the hind body are entirely black, while the whole of the raised margins of the preceding segments are pallid yellow, and this colour extends inwards at the front angle of each segment, so as to surround the stigmata. The legs, including the coxæ, are entirely pallid yellow, but the breast is all black. There are but few punctures on the elytra, and the two discoidal striæ are indistinct.

Sendai, Nikko, and Sanohé; four examples.

Oxyporus longipes, n. sp.

Rufo-testaceus; capite, elytrorum abdominisque apicibus nigris; antennis pedibusque flavis.

Long. 9 millim.

Antennæ rather long, fourth joint longer than broad, tenth but little longer than broad. Head elongate, entirely black, with a moderately deep fovea on the middle near the front. Thorax short, without constrictions or depressions. Scutellum and elytra reddish yellow, the latter with a large patch of black colour behind, with but few punctures. Three terminal segments of hind body black. Legs elongate, clear yellow.

Nikko, June 1880; one specimen.

This distinct species may be placed near the North-American *O. lateralis*, Grav.

Oxyporus humeralis, n. sp.

Nigerrimus, nitidus; antennis, palpis, pedibus elytrorumque plaga elongata humerali flavis.

Long. 10 millim.

Antennæ rather long. Head with a deep fovea on the middle in front. Thorax rather long and slender, narrowed behind, transversely depressed at the sides near the middle and less deeply so in front. Elytra black, with an elongate humeral patch yellow, the disk with numerous irregular punctures, the shoulders much produced. Legs rather long, clear yellow; hind coxæ black.

Nikko; one example.

Allied to *O. longipes*, though very different in colour and distinct in other respects; the example is a female, while the unique exponent of *O. longipes* is of the other sex.

Oxyporus hoplites, n. sp.

Niger, nitidus, ano piceo; elytris ad latera antrorsum vage flavescentibus; antennis palpisque piceo-rufis, illis extrorsum obscurioribus; prothorace posterius latiore, lateribus ante basin elevatis, subito constrictis angulo libero formantibus; elytrorum humeris acutis.

Long. 9 millim.

Antennæ rather long, penultimate joint only slightly transverse. Head slender, with a large fovea on the middle near the front; mandibles very long, the left one sinuate externally near the apex, the right one with a very large tooth. Thorax short. Elytra with the shoulders prolonged in front, a little sinuate at the sides and more or less rufescent there, the disk bearing numerous coarse punctures. Legs elongate, black; the tarsi red.

Two badly preserved examples, without locality.

This and the following two species may be separated as a distinct genus if intermediate forms are not discovered.

Oxyporus gnatho, n. sp.

Nigerrimus, nitidus; antennis articulo ultimo tarsisque ferrugineis; elytris sanguineis, angulo externo, sutura maculaque communi discoidali nigris; thorace ad latera posterius angulato.

Long. 11 millim.

Antennæ rather short, penultimate joints rather strongly transverse. Head with a small fovea on the middle near the front. Thorax short, the sides angulate near the base. Elytra bearing numerous coarse punctures, the shoulders prominent in front. Tarsi sulcate on the upper surface along the middle.

Nikko, June 1880; one specimen.

Allied to *O. hoplites*, but with many minor points of distinction.

Oxyporus biguttatus, n. sp.

Nigerrimus, nitidus; antennis, palpis pedibusque flavis, illis articulo basali nigro; elytris grosse punctatis, ad latera macula parva eburnacea.

Long. 7 millim.

Antennæ moderately long. Head with a large fovea on the middle near the front. Thorax short, the posterior angles spinose and acute, reposing on the shoulders of the elytra. Elytra with numerous large, irregularly placed, almost rugose punctures, at the sides a small ivory spot. The shoulders prolonged.

Miyanoshita, May 1880; one specimen.

Although allied to the preceding two species, this differs in many respects; the angles of the thorax are differently formed, and there is no tooth on the right mandible. I think this latter distinction is probably, however, a sexual one.

Subfam. *OXYTELINÆ*.

Group *OSORIINA*.

Osorius taurus, n. sp.

Cylindricus, niger; antennis pedibusque rufis; elytris rufo-piceis; abdomine piloso; capite thoraceque dense fortiter sculpturatis, illo anterieus utrinque longius producto.

Long. 8 millim.

Head very coarsely strigose, in front prolonged on either side to form an acute process projecting horizontally forwards as far as half the length of the mandibles. Thorax densely and very coarsely punctured, with a smooth space along the middle, the sides strongly sinuate just in front of the hind angles. Elytra longer than the thorax, rather sparingly and coarsely punctured. Hind body rough, with rather long, scanty, flavescent pubescence.

A species closely allied to this occurs in Ceylon (Trans. Ent. Soc. 1885, pt. ii. p. 332). The species is found commonly in decaying trees in the elevated forests of Central and South Japan.

Osorius microps, n. sp.

Parvus, rufus, fortiter punctatus, minus parce pilosus; tibiis externe tenuiter spinosis; elytris thorace vix longioribus.
Long. vix 3 millim.

Antennæ rather short, moderately stout, first joint less elongate than usual. Head much narrower than the thorax, coarsely, irregularly, subobsoletely punctured, eyes small. Thorax broader than long, straight at the sides till near the hind angles, then much narrowed, foveolate at the hind angles, lateral margin very fine; the surface vaguely sculptured, with an irregular, smooth, raised space along the middle. Elytra short, coarsely but subobsoletely punctate. Hind body thick, rather closely but indistinctly punctured, finely pubescent. Legs slender, tibiæ only slightly spinose externally.

Nagasaki, March 1st, 1881; one specimen.

Group OXYTELINA.

Bledius curvicornis, n. sp.

Nigricans; antennarum basi pedibusque pallide flavis; elytris testaceis plaga magna communi triangulari nigricante; prothorace transverso, medio canaliculato, obsolete punctato; antennarum articulo basali valde elongato.
Long. $4\frac{1}{2}$ millim.

Thorax obsoletely and rather sparingly punctate, dull, with scanty flavescent setæ, very definitely canaliculate, base rounded, hind angles absent. Elytra longer than the thorax, closely and not very finely punctate. Hind body shining black. Legs very pale yellow; front and middle tibiæ very densely spinose externally, hind tibiæ long and slender, clothed with a few fine hairs only. In the male the basal joint of the antenna is extremely long, curved, dilated, and sulcate at the extremity; the mandibles are long and each armed in front with a slender spine; on the middle of the forehead there are two minute, contiguous, acute tubercles, and the tubercles on which the antennæ are inserted are very prominent.

Sand-hills, Niigata, in September 1881.

This species is an ally of *B. verres* and *B. niloticus*, Er.

Bledius obtusus, n. sp.

Piceo-rufus, capite nigro; elytris rufis; antennis pedibusque testaceis; thorace minus transverso, nitido, dense fortiterque punctato, medio tantum breviter obsoleteque canaliculato.

Long. 4 millim.

Var. thorace nigro.

Antennæ rather slender, penultimate joints only slightly transverse. Head broad, eyes very convex. Thorax narrow, hind angles very obtuse, but not altogether absent, the surface shining, sparingly setose, coarsely punctate, with traces of a short channel on the middle. Elytra coarsely punctured, a little longer than the thorax. Front legs thick. Male with a spine on either side of the hind margin of the penultimate ventral segment; the space between the spines slightly emarginate and bearing a pallid membrane.

River-bank, Niigata, in September.

Not very similar to any species known to me, but may be placed in the neighbourhood of *B. procerulus*, Er.

Bledius cribratus, n. sp.

Niger; antennis pedibusque testaceis; elytris ad latera brunneis; thorace minus transverso, omnium densissime fortiterque punctato, nitido, medio parum distincte canaliculato; elytris fortiter punctatis, thorace longioribus.

Long. 4 millim.

This is closely allied to *B. obtusus*, but I have little doubt is distinct, as it is broader, and remarkable on account of the very dense coarse punctuation of the thorax. The male has characters similar to those of *B. obtusus*.

Nikko, June 1880; one specimen.

Bledius sellatus, n. sp.

Minus cylindricus, nigricans, flavo-setosus; pedibus elytrorumque plaga magna laterali pallide flavis; thorace fortiter transverso, basin versus angustato, angulis posterioribus minus obsoletis, medio canaliculato.

Long. 5 millim.

Antennæ rather short, thicker externally, penultimate joints strongly transverse. Head broad. Thorax nearly twice as broad as long, strongly narrowed behind, hind angles obtuse but quite distinct, the surface quite dull, obsolete punctured, with very distinct, short, pallid setæ, canaliculate throughout its length. Elytra much longer than the thorax, ample, blackish, with a large, pallid, lateral space on either side, broadest behind; very densely, moderately finely punctate.

Legs very pale yellow, middle and front tibiæ armed with strong but distant spines.

Hakodate, on the sand-hills.

This distinct species may be placed near *B. talpa*, Gyll.

Bledius pallipes.

Oxytelus pallipes, Grav. Mon. Col. Micr. p. 197.

Sapporo; one example.

I have some doubt whether this may not be a new species as it differs in some respects from European examples; but the differences are apparently slight.

Platystethus Quedenfeldti.

Platystethus Quedenfeldti, Weise, Deutsche ent. Zeitschr. xxiii. 1879, p. 147.

No locality more special than "Japan" has been recorded for this species.

Oxytelus gregarius, n. sp.

Piceus; antennarum basi pedibusque flavis; elytris brunneis; capite thoraceque subtilissime strigosis, opacis, aequalibus; abdomine nitidulo.

Long. $2\frac{1}{2}$ – $3\frac{1}{2}$ millim.

Antennæ short, the basal four joints yellow, the others nearly black, fourth joint minute, fifth a little broader, transverse, sixth to tenth each strongly transverse. Head entirely covered with a minute sculpture that renders it opaque, and extends quite to the front, otherwise even. Thorax strongly transverse, also dull and very finely sculptured, with traces of a median groove, and on each side with a still more indistinct groove. Elytra longer than the thorax, obsoletely sculptured.

Mr. Lewis procured a series of eight immature examples at Nikko, 18th August, 1881.

The sculpture brings this species near *O. laticornis*, but in size it is nearer to *O. mimulus*.

Oxytelus iners.

Oxytelus iners, Weise, Deutsche ent. Zeitschr. xxi. 1877, p. 94.

Hagi, on the shore.

This has not been procured by Mr. Lewis; it is said to be allied to *O. piceus*.

Oxytelus marginatus.

Oxytelus marginatus, Weise, Deutsche ent. Zeitschr. xxi. 1877, p. 96.

This apparently also has not been found by Mr. Lewis. I should think it must be near *O. mimulus*; the male is said to have very prominent mandibles. Found at Tokio, and thought to be probably not rare.

Coprophilus impressus, n. sp.

Niger, nitidus, pedibus sordide rufis; prothoracis dorso multi-impresso, lateribus crenatis; elytris abbreviato-striatis.

Long. $5\frac{1}{2}$ millim.

Antennæ stout, penultimate joints transverse. Head rather coarsely punctate. Thorax not so long as broad, on the middle towards the front with an elongate depression, near the base with two depressions, and with a very large, irregular, lateral impression on each side, the surface sparingly but rather coarsely punctate, very shining, the side margins very conspicuously crenate. Elytra much longer than the thorax, each with fine punctate grooves not reaching the hind margin.

This is an insect scarcely so large as *C. striatulus*, and has the thoracic impressions remarkably conspicuous; the elytral grooves deeper and connected behind, the hind margins of the elytra not reticulate.

Fukushima and Sapporo.

Coprophilus simplex, n. sp.

Niger; antennarum basi elytrisq. piccis, pedibus rufis; thorace elongato, obsolete impresso, irregulariter subtiliter punctato, marginibus lateralibus obsolete crenatis; elytris vage irregulariterque striato-punctatis.

Long. 6 millim.

Head deeply biimpressed in front. Thorax about as long as broad, much narrowed behind, hind angles obtuse, the surface irregularly punctate, with two obsolete impressions behind the middle. Elytra longer than the thorax, with irregular abbreviated series of punctures.

Wada-togé, 1st August, 1881; one specimen.

This species is not at all near any other; the irregular distribution of the thoracic punctuation, the depressions being absent, is peculiar.

Trogophlæus sericatus, n. sp.

Latus, subdepressus, nigerrimus, omnium subtilissime brevissimeque

pubescens, invisibiliter punctatus, opacus; prothorace fortiter transverso, ante basin profunde curvatim impresso.

Long. 3 millim.

Antennæ rather slender, slightly thicker externally, tenth joint as long as broad. Thorax broad, but much narrower than the elytra, very much narrowed behind, in front of the base with a deep curved impression (divided in the middle), otherwise unimpressed. Scutellum distinct. Elytra much longer than the thorax, quite dull.

Yokohama, Kumamoto, Midzusawa, Sanjo, in spring and autumn, scarce.

To be placed near *T. dilatatus*; remarkable on account of the very dull surface and excessively minute punctuation and pubescence.

Trogophlæus eminens, n. sp.

Latus, nigerrimus, omnium brevissime subtilissimeque pubescens, sat nitidus; elytris subtiliter punctulatis; prothorace basin versus maxime angustato, ante basin profunde curvatim impresso.

Long. $2\frac{1}{2}$ millim.

Closely allied to *T. sericatus*, but smaller and not so dull; the thorax is narrower, its surface is a little uneven, and the punctuation of the elytra is quite visible; the tip of the scutellum is minutely exposed.

Kiga; one specimen.

Trogophlæus deceptor, n. sp.

Sat latus, niger, sat nitidus, subtilissime pubescens; antennis pedibusque rufis; subtiliter punctulatus, prothorace ante basin profundius curvatim impresso.

Long. $2\frac{3}{4}$ millim.

This is closely allied to *T. eminens*, but has the antennæ and legs of a different colour and the elytra shorter; the prothoracic impression is remarkably deep and is not divided in the middle. The antennæ are not very long, but the penultimate joints are not transverse. The thorax is short, much narrower than the elytra, greatly narrowed behind. The elytra are longer than the thorax, very densely, finely punctate, and densely and finely pubescent, a little shining. The legs are red, the tibiæ infusate, with the apices paler and the tarsi yellow.

Yokohama and Nagasaki.

Although very different in appearance from the insect for which the genus or subgenus *Thinodromus* was proposed,

this species would belong thereto on account of the tip of the scutellum being minutely exposed. The colour apparently varies a little, the elytra being sometimes picescent.

Trogophlæus vagus, n. sp.

Niger; prothorace elytrisque nigro-piceis; antennis pedibusque rufis; prothorace fortiter transverso, vage obsoleteque impresso; elytris evidenter punctulatis.

Long. 3 millim.

Antennæ red, more obscure towards the extremity, the three terminal joints distinctly thicker than the others, but not transverse. Thorax much broader than long, greatly narrowed behind, but little narrower than the elytra, with an obscure longitudinal elevation along the middle and a very slight depression on each side of it; very densely and finely punctured. Elytra quadrate, longer than the thorax, densely and finely but distinctly punctured, a little shining. Legs pale red, unicolorous.

Yokohama, Nagasaki, Ogura Lake, Niigata.

Apparently the most common of the Japanese *Trogophlæi*.

Trogophlæus sedatus, n. sp.

Angustulus, niger, sat nitidus; antennarum basi pedibusque testaceis; elytris fuscis; subtilissime punctatus; prothorace obsolete impresso.

Long. $2\frac{1}{2}$ millim.

Antennæ with the three terminal joints stouter than the others, but not transverse. Thorax not strongly transverse, slightly narrower than the elytra, much narrowed behind, extremely delicately punctate and pubescent, a little shining, the surface slightly uneven, without definite impressions. Elytra much longer than the thorax, very delicately punctate and pubescent.

Nagasaki and Kobè.

Allied to the European *T. pusillus*, but larger, darker in colour, with longer elytra, &c.

Trogophlæus exiguus.

Trogophlæus exiguus, Er. Käf. Mark.-Brand. i. p. 604.

Niigata, September 1881.

A very widely distributed insect.

Group PHILÆOCHARINA.

DEROPS.

Corpus angustulum, minus depressum, dense subtiliter punctulatum.

Palpi maxillares articulo terminali præcedente fere duplo longiore. Tarsi omnes quinque-articulati, posteriores articulo basali cæteris conjunctis fere æquali; unguiculi minuti.

This is the most remarkable and peculiar of all the Staphylinidæ of Japan, and I do not know any genus at all near it. The front coxæ are elongate and exerted and the sides of the thorax possess a large triangular process behind the coxæ; a rather large fissure is left between this and the prosternum in which a trochanter is seen. The antennæ are eleven-jointed, slender and remarkably long. The mandibles are slender, curved, apparently without teeth, not crossing one another; the labrum appears to be large and prominent but membranous; the maxillary palpi are apparently only three-jointed, the third joint being longer than the basal joint and nearly twice as long as the middle joint. The middle coxæ are contiguous and rather large; the hind coxæ are prolonged backwards, but are short transversely. The legs are long, unarmed, the long tibiæ are more than twice as long as the tarsi; the hind tarsi are remarkably slender and linear. The antennæ are widely separated, are situated very near the front of the head, and have no tubercles over their point of insertion.

I can see no trace of ocelli, so that the insect cannot be placed in *Omalides*: had these organs been present the genus might have been placed satisfactorily near to *Lesteva*.

Derops longicornis, n. sp.

Elongatus, angustulus, posterius attenuatus, fusco-piceus, fere opacus, dense subtilissime pubescens; antennarum basi, palpis pedibusque rufo-testaceis: prothorace cordato: elytris elongatis. Long. corp. 5 millim., antenn. fere 3 millim.

Antennæ long and slender, scarcely thicker externally; from the seventh to the tenth each joint is rather shorter than its predecessor, and the terminal joint is not so long as the seventh. Head much narrower than the thorax, flat, very densely and finely punctate. Thorax elongate, sides rounded in front, much narrowed behind, hind angles definite, rather obtuse, the surface evenly, densely, and finely punctate, basal and lateral margins very fine. Elytra much longer than the thorax, densely (and rather more coarsely than the

thorax) punctured. Hind body slender, elongate, convex, the margins of the basal segments rather broad, those of the apical quite fine; the punctuation and pubescence are very dense and fine, the terminal segment ends with two long setæ, and there are three or four elongate setæ on the preceding segment. The male has on the terminal ventral segment a very narrow elongate excision, and on the preceding segment a large, deep, and broad depression, with raised margins, which apparently are minutely serrate or setose.

Ashinoyu, 18th March, 1880; one example.

[To be continued.]

XLIX.—*Descriptions of new Species of Rhynchota collected on or near the Kina Balu Mountain, North Borneo.* By W. L. DISTANT.

THE following descriptions refer to the principal novelties contained in a small collection of *Rhynchota* collected by Mr. John Whitehead in that interesting zoological and botanical locality, the Kina Balu Mountain. I have deliberately localized this paper as *on or near* Kina Balu, as a large portion of the collection showed such affinities to the fauna of the surrounding area that it is more than probable that many of the species (apart from those here described) if collected on the mountain must have been found at a low altitude.

Kina Balu appears to be the metropolis for the Eastern Fulgoridæ, and I have never seen a collection made in a similarly limited area contain such a number of the pseudo "lantern-flies" as this one made by Mr. Whitehead. The following are the species:—

Pyrops nobilis, Westw.
Fulgora sultana, Adams.
— *gigantea*, Butl.
— *subocellata*, Guér.

Fulgora pyrorhyncha, Don.
— *intricata*, Walk.,
var. *stellata*, Butl.
— *Whiteheadi*, Dist.

The remainder of the collection calls for little comment.

HETEROPTERA.

Fam. Coreidæ.

Prionolomia nigrovittata, n. sp.

Cinnamomeous; antennæ, a central longitudinal line to

pronotum, margins of scutellum (narrowly), outer margins of clavus (broadly), sternal sutures, lateral margins of mesonotum, metanotum, and abdomen, and the posterior tibiæ blackish; membrane dark brown.

Antennæ with a little less than the apical half of fourth joint ochraceous; first and fourth joints subequal in length, second joint a little longer than third. Pronotal angles strongly, upwardly, and sublunately produced, their apices subacute, their margins finely serrate. Rostrum reaching the intermediate coxæ.

♂. Posterior femora strongly incrassated, with three small but distinct black tubercles above, a strong black spine beneath at about centre and two smaller subapical spines of the same colour; tibiæ flattened and channelled, and inwardly toothed at about one third from apex.

Long. 27 millim., exp. pronot. angul. 13 millim.

HOMOPTERA.

Fam. Cicadidæ.

Leptopsaltria mascula, n. sp.

♂. Head, pronotum, and mesonotum greenish ochraceous; head with the margins of front, anterior margins of vertex, inner margins of eyes, and the area of the ocelli black; pronotum and mesonotum with the following black markings:—pronotum with two central longitudinal fasciæ, widened anteriorly and rounded and united posteriorly, the incisures, a large spot on lateral margins and three spots on posterior margin, the central one smallest and linear; mesonotum with five fasciæ, one central, widened and somewhat cordate posteriorly, an abbreviated one on each side, followed by another completely crossing disk, two small spots in front of the cruciform elevation. Abdomen castaneous, the segmental margins pitchy and a spot of the same colour at base. Head and thorax beneath, legs and opercula greenish ochraceous, face with black striae, head spotted with black, apices of the tibiæ and tarsi blackish. Abdomen beneath castaneous, with the tubercles and apex black. Tegmina and wings pale hyaline, the venation ochraceous; tegmina with the apex slightly infuscated, a small black and ochraceous spot at base of upper ulnar area and the transverse veins at bases of second and third apical areas darkly infuscated.

The rostrum reaches the posterior coxæ, the opercula are angulated, the outer and posterior margins nearly straight.

♂. Long. excl. tegm. 28 millim., exp. tegm. 78 millim.

Allied to *L. samia*, Walk.

Cosmopsaltria montivaga, n. sp.

Allied to *C. lauta*, Dist., but differing by its larger size, broader and more robust body, the absence of the sublateral fascia of the pronotum, and the presence of an oblique black pronotal spot behind the eyes; the markings of the mesonotum smaller and the sublateral fascia curved and not extending to anterior margin. Opercula broader at base, not so concave internally, much more narrowly black at apex and inner margin, and crossed at centre by a transverse dark castaneous fascia.

Long. 40 millim., exp. tegm. 120 millim.

Pomponia viridimaculata, n. sp.

♂. Body above castaneous; ocelli, eyes, and posterior margin of pronotum ochraceous; mesonotum very dark castaneous, with two obscure contiguous obconical spots at anterior margin; face, anterior margins of head beneath, and legs blackish; apices of the femora ochraceous, posterior tibiae castaneous, their bases and apices blackish.

Tegmina and wings pale hyaline, the venation brownish ochraceous; tegmina with the costal membrane pale castaneous, the transverse veins at the bases of the second and third apical areas, and the apex of the longitudinal vein defining the upper apical area, broadly and darkly infuscated, and a distinct bright green basal streak; wings with the inner claval margin green, with a fuscous streak, the outer claval margin fuscous.

Body elongate, the face very robust and rounded; the rostrum reaching the posterior coxæ; opercula short, obliquely rounded outwardly, obliquely straight inwardly.

Long. ♂ 52-55 millim., exp. tegm. 135 millim.

Pomponia Græcina, n. sp.

♀. Allied to *P. fusca*, Oliv., but differing by having the two central fasciæ of the pronotum much more diverted anteriorly, the two central obconical spots on the mesonotum much more contiguous, and all the tegminal macular markings on the transverse veins at bases of apical areas and at the apices of the longitudinal veins of the apical areas larger and more infuscated. The rudimentary opercula, as compared with those of the same sex of *P. fusca*, are convex and rounded externally and not moderately angulated.

♀. Long. 31 millim., exp. tegm. 110 millim.

Fam. **Fulgoridæ.***Fulgora Whiteheadi*, n. sp.

Thorax above, head, and cephalic process olivaceous; pronotum, excluding anterior margin, ochraceous; body and legs fuscous, the abdominal segmental margins above olivaceous. Tegmina olivaceous brown, the venation and reticulations olivaceous, excepting on apical area, where they are ochraceous, and ornamented with a number of small ochraceous rounded spots, situate in more or less irregular transverse series, each containing about four spots, those on apical area smallest; wings bright dark blue, the apical area and outer margin broadly black, this dark coloration inwardly deeply sinuate. Cephalic process somewhat short, ascending, broadened and flattened for apical half.

Long. from eyes to apex, abdomen 19–22 millim.; cephalic process from eyes to apex 10 millim.; exp. tegm. 63–71 millim.

This species is allied to *F. Delessertii*, Guér., from which it differs by the paler colour, different arrangement, and smaller size of the spots on the tegmina, the deeply sinuate internal margin of the black area of the wings, but chiefly by the shape of the cephalic process, which is widened and flattened at apex.

L.—*Note on a remarkably large Specimen of Luidia from the Island of Mauritius.* By Prof. F. JEFFREY BELL, M.A.

THE Trustees of the British Museum have recently purchased from M. de Robillard, the well-known collector in the island of Mauritius, two large specimens of *Luidia Savignii*. Both of these have nine arms, and the larger specimen is remarkable for having all the arms complete, and none of them bear any mark of injury or repair. Throughout its life, therefore, the creature was able to give its sole attention to its growth, and it succeeded in developing a disk of 95 millim. in diameter and nine perfect arms, of which the longest measures 370 millim. and the shortest 350 millim. This specimen is therefore more than twice as large as M. de Lorient's "deux individus de grande taille," whose "diamètre total atteint 320 mm." It is, I think, well to put on record the dimensions of what is, I fancy, the as yet largest known Asterid;

to the measurements already given it may be added that the greatest breadth of the arms is 50 millim. It is not a little remarkable that a *Luidia* should have attained to so great a size without any injury to its arms, and it is certainly to the credit of M. de Robillard that he has succeeded in safely sending so large and fragile a specimen safely to this country.

In the large central mouth there were found the remains of a *Stomopneustes variolaris*; a number of still uninjured or undigested spines suggests that the starfish had not quite relished the prickliness of his prey; on the other hand, we may suppose that it was necessary to acquire a quantity of carbonate of lime by some means or other, and even at the expense of some personal inconvenience.

The largest British specimens of *Luidia* as yet in the British Museum measure respectively 425 and 426 millim. in spread, have the disk 53 and 69 millim. in diameter, and the longest arms 223 and 220 millim.

Of other large specimens of which I have heard from Professors M'Intosh and Herdman, and Mr. W. Percy Sladen none are credited with a wider spread than 18 inches, and there appears to be no record of any fossil species attaining to any such large size*.

What interest there is in this communication lies in the announcement of the gigantic size of a starfish; I have nothing to add to the, as usual, complete account of the species which we owe to M. de Loriol †.

LI.—On two new Species of Birds from Kina Balu Mountain. By R. BOWDLER SHARPE, F.L.S., F.Z.S.

MR. JOHN WHITEHEAD, who is about to travel in South-eastern Africa, has asked me to describe a new species of Barbet which he discovered on Mount Kina Balu, in Northern Borneo. I at first thought it might represent one of the many phases of plumage through which *Megalopneuste mystacophanus* passes before it becomes fully adult. A close exami-

* An *Asterias glacialis* in the Museum has a spread of 450 millim., with a disk of 55 millim. diameter, and the greatest arm-length 220 millim. Mr. R. L. Spencer, of Guernsey, tells me he has seen specimens a little over 18 inches.

† Mém. Soc. phys. et d'hist. nat. de Genève, xxix. no. 4, p. 72.

nation, however, convinces me that it is a distinct species, different from any eastern Barbet yet known.

I propose to call it

Cyanops monticola, sp. n.

♂ *ad.* Prasino-viridis, alis et cauda saturatioribus; fronte et loris smaragdinis, sincipite et pilei lateribus lute cyaneis; plaga magna verticali scarlatina usque ad nucham producta; facie laterali et regione parotica pallide cyaneis, fascia supraparotica smaragdina; genis gulaque pallide flavis, hac infra cyanescente et macula scarlatina ad latera juguli posita ornata; præpectore et corpore reliquo subtus pallide smaragdinis.

Long. tot. 9·0, culm. 1·15, alæ 3·9, caudæ 2·5, tarsi 1·05 poll. Angl.

The nearest ally of this species is *Cyanops incognita*, Hume, from Tenasserim. It differs, however, from that species in its larger size, in the absence of the black facial stripes and red loreal spot, as well as in the colour of the throat, which is bright bluish green in *C. incognita*.

I take this opportunity of observing that the *Chlorura* which I described in the 'Ibis' for 1887 (p. 453) as *C. hyperythra* of Reichenbach turns out to be distinct from that species, having the rump and upper tail-coverts like the back. I propose to call it *Chlorura borneensis*.

LII.—*The Polyzoa of the St. Lawrence: a Study of Arctic Forms.* By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Plate XXI.]

[Continued from vol. i. p. 227.]

Suborder * CHEILOSTOMATA.

Family Escharidæ (part.), Smitt.

RHAMPHOSTOMELLA, Lorenz.

Rhamphostomella, Lorenz, Bryozoën von Jan Mayen, gesammelt von Dr. F. Fischer, Arzt der österreichischen Expedition auf Jan Mayen, bearbeitet von Dr. Ludwig Lorenz, 1886.

This genus has been instituted by Lorenz for a group of species which is very characteristic of the Arctic and Northern

* In the first part of this Report ('Annals' for March 1888, p. 215, line 12 from the top) for "Subclass" read "Suborder."

seas and is well represented in the St. Lawrence. The *Eschara scabra* of Fabricius, subsequently described at length and figured by Smitt, is a member of it and the first of which we have any notice. Smitt referred this species and kindred forms to the genus *Cellepora*, and I have followed him (but only provisionally) in a paper (1877) containing descriptions of new Arctic Polyzoa. Probably Lorenz is right in regarding them as a distinct generic group, though his diagnosis may require amendment. They are properly detached from *Cellepora*, a group which has already been dismembered to some extent by Smitt, and which awaits a more thorough revision. The species included in the genus *Rhynchostomella* have some affinity with *Mucronella*, but they are differentiated from it by special characters and a general habit which are sufficiently significant.

Lorenz's diagnosis of his new genus is as follows:—

Zoëcia generally oval, very regularly alternate, slightly prominent; orifice terminal, broad, semicircular, closed by a thin membranous operculum, surrounded in front and at the sides by an elevated peristome, with a central notch, on one side of which an avicularium is usually placed; the half of the peristome bearing the avicularium, as compared with the other, very strongly developed, and often standing out like the rostrum of a *Cellepora*. *Oœcium* hemispherical and perforated. *Zoarium* unilamellar.

Now one of the principal characters included in this description—the elevated peristome, cleft in front—is by no means constant throughout the group. In *R. plicata*, Smitt, *R. bilaminata*, Hincks, and *R. radiatula*, id., it is present, and a very striking feature; but there is no trace of it in *R. ovata*, Smitt, *R. costata*, Lorenz, and *R. scabra*, Fabricius (?). It cannot therefore be employed with propriety as a principal diagnostic.

Verrill refers *R. scabra* and *R. ovata* to "*Mucronella* (restricted)"*; but as his restriction excludes from the genus all forms which are not furnished with "lateral avicularia on one or both sides of the zoëcial aperture" and destitute of "the median avicularium," these species have certainly no claim to a place in it.

On the whole I should be inclined to adopt Lorenz's genus with a revised diagnosis:—

Zoëcia oval, the walls thin, of delicate shining material, smooth (frequently traversed by radiating costæ), entire (destitute of pores); orifice ample, arched above, lower mar-

* "Notice of Recent Additions to the Marine Invertebrata of the North-eastern Coast of America," &c., Proc. U.S. Nat. Mus. 1879, p. 195.

gin straight or slightly curved, within it a median denticle, below it or upon it an aviculiferous rostrum. *Oœcium* semi-circular or subcrescentic, perforated.

The remarkable delicacy of the material of which the cells are composed in all the known species and the total absence of strong calcification are characteristic points. The walls are thin, with a smooth and shining surface, in some cases traversed by radiating ribs, and of a whitish colour. The operculum which closes the orifice partakes of the same delicacy of structure and is simply membranous.

Rhamphostomella costata, Lorenz. (Pl. XXI. figs. 6, 7, 8.)

Cellepora scabra, Smitt *ex parte*, Kritisk Förteckn. &c., iv. p. 30, pl. xxviii. figs. 186-188.

Smitt has ranked under his typical *C. scabra* the present form, which has been rightly treated as a distinct species by Lorenz. It is abundant amongst the St.-Lawrence dredgings in company with *R. plicata*, Smitt, and *R. bilaminata*, Hincks.

In different stages of growth it varies much in appearance, as a reference to the figures (Pl. XXI. figs. 6 and 8) will show. In figure 7 a group of young marginal zoœcia is represented, which agrees in character with the stage of growth figured by Lorenz. A remarkable development of the superficial costæ (also on the younger cells) is shown in figure 8. Radiating from the side of the cell they pass upward to the summit of the suboral rostrum, the delicate white lines forming large areolæ round the margin, through which the smooth and silvery surface is visible. In this condition the aspect of the species is completely changed. An equally striking change is met with if we pass from the border of the colony to the interior. In this region the oœcia, which are of large size, are commonly present in great numbers, crowding one upon another and completely concealing the surface of the cells. In this portion of the colony too gigantic avicularia frequently occur in addition to the ordinary form, which is usually reduced in size and much less prominent than usual, the rostrum being either suppressed in great measure or concealed by the larger avicularium which rises in front of it. The latter is very tall and massive and of the same shape as the smaller form; it is either suberect or recumbent. I have not noticed these gigantic avicularia except on cells furnished with an oœcium; but they are not always present on these.

A varietal form of this species occurs (var. *cristata*, Pl.

XXI. fig. 6) in which a remarkable change of general aspect is brought about by a very slight and unimportant structural peculiarity. The stout suboral rostrum which bears the avicularium carries on its summit a small transverse bar, which is formed by the beak which bends at one side over the mandible, and by a spinous process or spur which projects from the opposite side. This trifling variation gives a very peculiar and picturesque appearance to the colony. In some cases the zoarium is overspread continuously with a white epidermal investment, beneath which the radiating costæ are faintly traceable (Pl. XXI. fig. 6). The mandible of the avicularium tapers off above into a finely acuminate point which bends inward. Retraction is effected by means of two rather long muscular bands, which are attached to the inner surface, one on each side, about halfway between the apex and the base. Lorenz makes no mention of oral spines, but on marginal cells traces of six are distinguishable.

Range (of the genus). Northern and Arctic Seas.

Family Cellulariidæ.

SCRUPOCELLARIA, Van Beneden.

Scrupocellaria scabra, Van Beneden.
(Pl. XXI. fig. 1.)

In the remarkable form of this well-known northern species which I have figured one important element of the normal structure is altogether wanting—the one, indeed, which constitutes the distinction between the genera *Menipea* and *Scrupocellaria*. The former is characterized by a definite and well-developed system of avicularian appendages, the latter possesses in addition an equally definite system of vibracula. But in this St.-Lawrence form of *S. scabra* the vibracula have disappeared, and, in fact, there is nothing apparent to separate it from *Menipea*. At the same time the avicularia usually present towards the base of the zoecia on the front surface of the cell are altogether absent, and the lateral avicularium is the sole surviving appendage. In the other structural elements there is a complete resemblance between the present variety and the normal *S. scabra*, so that we cannot hesitate to refer it to the latter species. I have already pointed out that in *S. scabra* “the vibracula are commonly wanting on many of the cells” *; but though this shows a certain amount of instability in the structure, it would not prepare us for its total obliteration.

* ‘History of the British Marine Polyzoa,’ vol. i. p. 50.

In one of his papers * Jullien has stated that he had seen a colony of *Scrupocellaria scabra* from Greenland on which not a single vibraculum was present, but the avicularia on the front surface were strongly developed. In the case of the St.-Lawrence form the latter also have disappeared. It may be noted that in this species, in which the vibracula are of such uncertain occurrence, these appendages are of most rudimentary structure, and a very slight modification of the avicularium. The scutum in the present form is very highly developed and of exceptionally large size, in some cases almost completely concealing the oecium.

The normal form of *S. scabra* occurs in the St. Lawrence.

Range. Gaspé Bay, St. Lawrence ; Greenland.

Family *Escharidæ* (part.), Smitt.

PORELLA, Gray.

Porella concinna, Busk. (Pl. XXI. fig. 4.)

This is one of the most abundant species in the St. Lawrence, and exhibits a large amount of variation. One of the prettiest varieties is represented in figure 4. The remarkable diversity in the condition of the cell-wall, which is such a marked characteristic of the Polyzoa, receives ample illustration in this species ; commonly the surface is uniformly granulous, and a line of rather large punctures runs round the margin of the cells. In other cases the surface is perfectly smooth and white and the margin of the cell is strongly sinuated and punctured.

This very marked form is the *Lepralia Belli* of Dawson, and is extremely abundant in the St. Lawrence. In yet another (which occurs in the North Pacific) the whole surface of the cell, except the suboral umbo, is covered with rather large punctures ; in another even the marginal punctures are obliterated by the calcification or altogether absent. Such facts, and they might be multiplied to almost any extent, suggest a serious objection to Dr. Jullien's proposal to employ the characters of the front wall for classificatory purposes—to make them primary tests of natural affinity. The practical difficulties in the way would seem to be great ; but I am by no means disposed to deny that in many cases they may yield valuable help to the systematist.

In the cells on the growing edge of the colony and in the neighbouring region the avicularium is borne on the summit

* "Dragages du Travailleur. Bryozoaires : espèces draguées dans l'océan Atlantique en 1881," Bull. de la Soc. Zool. de France, t. vii. (1882).

of a prominent mamillary rising, which extends across the front wall from side to side immediately below the orifice. In the older cells this is completely enveloped and concealed by the growing accumulations of calcareous matter. Lorenz has met with specimens in which the condition of the younger cells is permanent and the avicularian mamillæ are conspicuous throughout the colony*. So completely is the appearance changed in this specimen that he was at first disposed to refer it to a distinct species. He describes the cell as being "von milchweisser Farbe und ziemlich dünnwandig." From some cause there had been an arrest of calcification.

In many colonies the avicularia are present in great numbers distributed irregularly over the cells; sometimes one is placed immediately above the orifice, sometimes at the side of it or on each side. Frequently these sporadic avicularia are borne on a prominent mamilla.

Range. *P. concinna* has a very wide range. Common in the Northern and Arctic seas; Britain; Mediterranean; Australia.

Porella acutirostris, Smitt. (Pl. XXI. fig. 5.)

This well-marked species has been described and figured by Smitt; but as yet, I believe, no diagnosis has appeared in English, whilst the figures accompanying the excellent account of it which we have from the Swedish author are too small to be quite satisfactory†.

Zoecia somewhat elongate-oval, distinct, convex, disposed in regular lines; surface minutely granular, of a whitish colour; orifice much broader than high, arched above, lower margin straightish, slightly curved inward in the centre; peristome not elevated (except in the fertile cells); immediately below the orifice a prominent mamillary rising, extending across the cell, bearing a triangular *avicularium*, the mandible directed straight outwards. *Oecium* large, prominent, globose, with a granular surface; a projecting border above the oral arch which meets the elevated peristome at each side.

The *zoecia* in this species are larger than those of its congener *P. concinna* and more distinct and convex. The avicularian umbo rises much more abruptly than in *P. concinna*, and it remains distinct over the whole colony, very slightly affected by the calcification in the specimens which I have

* 'Bryozoën von Jan Mayen,' *l. c.* p. 8, pl. vii. fig. 6.

† Lorenz (*l. c.* p. 8) has given a brief notice of some of the characters of the *zoecium*.

examined. The oœcium, with its conspicuous oral border, is a striking feature as compared with that of *P. concinna*.

Smitt describes the front wall as thickly punctured; but in the St.-Lawrence specimens it is uniformly granular; there are faint traces of marginal punctures.

Range. Spitzbergen; Greenland; Jan Mayen.

SMITTIA, Hincks.

Smittia producta, Packard. (Plate XXI. fig. 2.)

A number of species from the coast of Labrador have been described by Packard *, of which the above is one. I confess that I have been unable to identify most of them with any certainty, even with the help of Prof. Verrill's notes upon them. The diagnosis is generally insufficient, and the figures, when there are any, are not of a kind to give much assistance. The form which I have figured (Pl. XXI. fig. 2) I refer doubtfully to Packard's species. It answers pretty well to his description, which is not a very precise one, and in the shape of the orifice and the cell it agrees with his figure, which is small and obscure, and gives scarcely any detail. I have received from Sir J. W. Dawson a tablet bearing a specimen which is marked "*Lepralia producta*, probably Packard's spec.," and which is identical with the form which I refer to this species.

It is very doubtful how far it is well to allow the claim of defective diagnosis and to give a place in our system to identifications which are of necessity largely conjectural. I believe that science would be the gainer, while the student would be spared much fruitless labour, by the exercise of some rigour in this matter.

The following is a description of the St.-Lawrence species, which seems to be probably identical with Packard's *Lepralia producta*.

Smittia producta, Packard (sp.).

Zoœcia large, ovate, often pointed below, irregularly disposed, very slightly convex (almost flat when old), surrounded by raised lines, usually highly calcified, the walls thick and dense; surface covered with numerous punctures, a conspicuous line of larger pores round the margin; (in young cells) roughened by ridge-like elevations and glistening, (in older states) of a dull whitish colour, almost smooth or minutely granu-

* "List of Animals dredged near Caribou Island, Southern Labrador, 1860," Canadian Naturalist and Geologist, vol. viii. (1863) p. 401.

lated; orifice (primary) semicircular, lower margin straight; (secondary) orbicular, with a deep sinus, tapering off gradually to a point below; peristome thickened, slightly raised, on each side of the sinus a nodulous collar-like rising. *Oecium* subglobose, prominent (when not concealed by the progress of calcification), a projecting rim round the oral arch; surface smooth or minutely granulated.

Avicularia none.

There is considerable variation in the form of the secondary orifice, dependent upon age; in the adult state it is as described above. Young fresh colonies are reddish brown, but in older specimens the surface is of a dull white colour.

Verrill has referred Packard's species to *Escharoidea Sarsii*, but the history of the development of the cell is quite different in the two forms, and in no stage of growth is there any trace of the oral avicularium which is so essential a character of the latter.

MUCRONELLA, Hincks.

Mucronella spinulifera, n. sp. (Pl. XXI. fig. 3.)

Zoecia rudely ovate, often much elongated and truncate below, sometimes pyriform, variable in shape and size, quincuncial, but not regularly so, very convex and divided by deep sutures, strongly calcified; surface thickly covered with small granules, shining; orifice well arched above, the sides curved outwards, lower margin straightish, with a slight elevation in the centre which is carried up into a very small spinule; peristome unarmed and not elevated. *Oecium* inconspicuous, subimmersed, rounded, broad in proportion to its height; surface granular. *Avicularia* none.

Colony of a reddish colour.

This is a somewhat striking form. The colour, the glistening granular surface, the prominent deeply-divided cells, and the peculiar character of the orifice, with its single spinule on the lower margin, combine to give it a very distinctive aspect. So far as I know it is undescribed.

Hab. On shells, stones, &c.

Family Eucratiidæ.

SCRUPARIA, Hincks.

Scruparia clavata, Hincks.

This is an interesting addition to the fauna of the St. Lawrence. *S. clavata* was first discovered in Filey Bay, on

the Yorkshire coast, where I met with it abundantly on some of the Crisiidæ. I have also found it in Lamash Bay and on a *Cellularia* from Shetland (probably). These were the only known localities for it. It now proves to be abundant amongst the St.-Lawrence dredgings on *Crisia*, which seems to be its favourite habitat. It takes its place amongst the Northern forms which have migrated to our coasts by way of Shetland.

Family Pedicellinidæ, Hincks.

PEDICELLINA, Sars.

Pedicellina nutans, Dalyell. (Pl. XXI. fig. 9.)

The form which I have identified with Dalyell's species * occurs plentifully and of large size in the St. Lawrence; and a further examination of it has confirmed me in my opinion that it is specifically distinct from *P. cernua*.

Jullien † has questioned the validity of this species and considers that it may probably be no more than a variety of *P. cernua*. But he has hardly done justice to the characters upon which I rely as distinctive. The small size comparatively of the zoecium and the constriction of the pedicel below it are by no means the only points nor yet the most significant in which it differs from the latter species. I have insisted on the remarkable difference between the shape of the body in the two forms, which is well shown in my woodcuts, figs. 39 and 40, as a most important character. There is a group of distinctive characters which, in my judgment, amply justifies my view. The very characteristic pedicel (broad below and tapering rapidly upward to a subacuminate extremity), the constant absence of spines, the symmetrical vase-like body, destitute of the gibbosity on the dorsal side, so characteristic of *P. cernua*, are significant points of difference which prevent me from accepting Dr. Jullien's criticism.

The Pedicellinidæ abound in the Northern seas. The St.-Lawrence dredgings have already yielded *P. nutans*, Pallas, *Barentsia major*, a fine new species described in my last paper, and *B. gracilis*, Sars. *B. bulbosa*, Hincks, is a native of Barents Sea.

I have figured *B. gracilis* (Pl. XXI. fig. 10) for comparison with *B. major* ('Annals' for March 1888, pl. xv. fig. 2) and also to show the great variability in the length of the muscular cylinder.

* 'British Marine Polyzoa,' vol. i. p. 567, woodcuts figs. 37, 38, and 40.

† 'Bryozoaires recueillis par la Mission du Cap Horn,' pp. 1-10.

Dr. Jullien's critical remarks on the classification of the Pedicellinidæ I hope to notice on some future occasion.

EXPLANATION OF PLATE XXI.

Fig. 1. *Scrupocellaria scabra*, Van Beneden. Form destitute of vibracula.

Fig. 2. *Smittia producta*, Packard.

Fig. 3. *Mucronella spinulifera*, n. sp.

Fig. 4. *Porella concinna*, Busk, var.

Fig. 5. *Porella acutirostris*, Smitt. a. Orifice of zoecium. b. That of *P. concinna*.

Fig. 6. *Rhamphostomella costata*, Lorenz, var. *cristata*.

Fig. 7. The same. Group of marginal cells.

Fig. 8. The same. Young cells, showing the superficial costæ.

Fig. 9. *Pedicellina nutans*, Dalyell.

Fig. 10. *Barentsia gracilis*, Sars. (For comparison with *B. major*, Hincks, 'Annals' for March 1888, pl. xv. fig. 2.)

LIII.—Description of a new Species of Mus from South Australia. By OLDFIELD THOMAS.

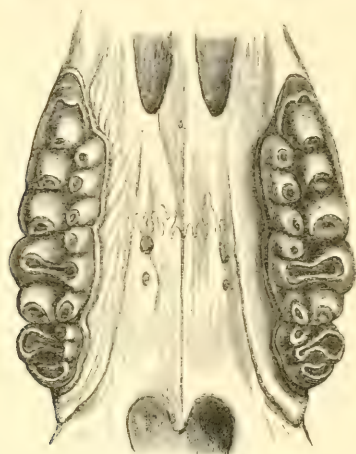
Mus argurus, sp. n.

Size about equal to that of a small *Mus nanus* or large *M. albo-cinereus*. Fur crisp or even slightly spinous. General colour above pale sandy rufous, the hairs slate-coloured at their bases. Ears very thinly covered with fine white hairs, rounded, laid forward they reach just beyond the middle of the eye. Muzzle and underside of body white, the line of demarcation on sides not sharply marked; hairs of chest and belly pale rufous basally. Hands and feet pure white. Soles smooth, naked, with six well-developed rounded pads, the posterior one elongated. Tail rather longer than the head and body, quite uniform in colour above and below, more thickly covered with hairs than usual, the hairs pure white, the scales (which average about thirteen or fourteen to the centimetre) pale flesh-coloured; tip of tail slightly pencilled. Palate-ridges nine, three anterior undivided and six divided, interdental, of which the anterior is directly transverse, while the others are slanted backwards mesially.

Skull smooth and unridged. Nasal and interorbital regions flat, evenly convex when viewed in profile; supraorbital edges sharply square, but not beaded or ridged. Interparietal broad antero-posteriorly, its diameter in this direction more than half its transverse breadth. Anterior edge of

outer wall of infraorbital foramen evenly convex, not overhanging above, or hollowed out below. Palatine foramina reaching to just between the anterior corners of the first molars. Posterior nares broad, the spine in the centre of the posterior edge of the palate unusually well developed. Bullæ small, transparent.

Teeth.—Incisors pale orange above, yellow below. Upper molars (see fig.) very narrow and elongated, their inner cusps



Mus argurus. Upper molar teeth, magnified about 7 diameters.

all along unusually well developed, while their outer ones are almost obsolete. $M.^1$ with a small secondary cusp on its anterior side, exactly as in the Indian *Leggada* *; laminæ three in number as usual, but the external cusps on these laminæ extraordinarily reduced, obsolete on the first and third laminæ, and nearly so on the second; on the other hand, the inner cusps are very large, the third lamina even, which generally has no internal cusp, having one quite as large as the others. $M.^2$ with two laminæ as usual, each of which has its small internal cusp, in addition to the antero-internal cusp always present in *Mus*, there being therefore three internal cusps to the tooth †. $M.^3$, $m.^1$, $m.^2$, and $m.^3$ as usual. The dentition is

* See Proc. Zool. Soc. 1881, p. 552, pl. li. fig. 10.

† This fact is most important, as it seems to me to negative Dr. Winge's suggestion ("Jordfundne og Nulevende Gnavera fra Lagoa Santa," E Mus. Lund. iii. p. 125, 1887) that the ordinary antero-internal cusp of this tooth in *Mus* is that originally belonging to the first lamina, while that opposite this lamina really belongs to the next one, the two having been pushed out of their normal positions by the increase in size of the

therefore very similar to that found in certain members of the genus *Hapalotis*, and particularly in *H. hirsutus*, Gould, of which the molars are almost identical in structure with those of the present species.

Dimensions of the type, an adult male in spirit:—

Head and body 83 millim.; tail 101; hind foot 22; ear 14; forearm and hand 25; head to front of last foot-pad 10·3; length of last foot-pad 2·4. Skull: basal length 24·6; greatest breadth 14·0; nasals, length 11·2; interorbital breadth 4·8; interparietal, length 5·0, breadth 8·3; length of outer wall of infraorbital foramen 3·1; palate, length 16·0, breadth outside $\frac{m.1}{m.1}$ 5·9, inside $\frac{m.1}{m.1}$ 3·0; diastema 7·9; length of anterior palatine foramina 5·5, of upper molar series 5·5.

Hab. South Australia.

Mus argurus has therefore the external characters and the skull of *Mus*, with the molars of *Hapalotis*; and I am somewhat in doubt as to which of the two it should be put into. It seems indeed probable that the characters of these two genera will be found so to blend together in the different species as to necessitate their ultimate union, notwithstanding the very striking characters presented by the more typical species of *Hapalotis*.

Pending a general revision of the Australian Muridæ, however, I refer the present new form to *Mus*, the differences in the teeth appearing not to be of very great systematic importance, while its external form, and especially the proportions of its hind feet, are wholly those of *Mus*, and in no way recall those of the Jerboa-like *Hapalotis*.

Of species already described none can be confounded with this, as, apart from its peculiar teeth, it is readily distinguished from all by its wholly white tail.

BIBLIOGRAPHICAL NOTICE.

Bulletin Scientifique de la France et de la Belgique. Publié par
A. GIARD. Tome xix. 8vo. Paris: Octave Doin, 1888.

IN the year 1869 M. Alfred Giard, then Professor in the "Faculté des Sciences" at Lille, started a new periodical under the title of 'Bulletin Scientifique du Département du Nord et des Pays voisins.'

other cusps. That the internal cusp attached to the anterior lamina really belongs to it, and not to the second lamina, has always appeared to me far more natural, and the state of things in *Mus argurus* and in *Hapalotis* strongly supports this view.

This journal was more or less definitely connected with the Faculty of Sciences at Lille, although it by no means limited its work to the Department of the North or even to France; under the direction of Professor Giard it may be regarded specially as the exponent in France of Darwinistic ideas, which, at the time of its establishment, were by no means popular among French naturalists. For a long time, indeed, M. Giard was almost the only French zoologist of repute who adopted the heterodox English theory, and many of our readers will remember the rather contemptuous fashion in which the theory of Natural Selection was treated by some of the leaders of scientific opinion in France.

The 'Bulletin Scientifique,' however, managed to hold its own, and up to the end of the year 1887 eighteen volumes were published in the original form. They contained numerous valuable contributions, especially in the department of zoology, of some of which translations have appeared in this Journal; and the connexion of the Editor with the Marine Laboratory at Wimereux, near Boulogne, enabled him to furnish its pages with many articles upon the zoology of the shores of the Pas de Calais which are of special interest to British naturalists.

In the meantime Darwinistic views have gained ground to a considerable extent in France, and some few years ago M. Giard was appointed to a professorial position in Paris, where he has since continued his labours in teaching; and last year, on the completion of the second series of nine volumes of the original 'Bulletin,' this publication also made a fresh departure, and, while still retaining its connexion with the older journal, as indicated by the number of the volume, not only adopted the more ambitious title which stands at the head of this notice, but also enlarged the size of its pages and introduced a very liberal allowance of plates for the illustration of the papers occupying them. As the present volume is the first of a new and greatly improved series of this important periodical, we have thought it worth while to bring it under the notice of the readers of the 'Annals.'

When we look at the articles which it contains we cannot but feel that the regular contributors to this journal are following in the footsteps of Charles Darwin at least as closely as the naturalists of any other country. Not that they devote themselves particularly to the formal development of the idea of evolution, which they may not unjustly regard as placed above the reach of attack; but they rather, while working in the spirit of the theory, follow the example of their great leader by the prosecution of researches into the history of the organisms studied by them, less as things to be dissected and sectioned than as living entities, having functions to perform in nature and important relations to one another. In fact nearly all even of the descriptive papers in this volume are worked in this spirit.

As examples of this we may notice especially the descriptions of two new genera of Epicarides, *Probopyrus* and *Palepyge*, by MM. Giard and Bonnier, an abstract of which appeared in our issue for

March 1888, M. E. Canu's paper on the free marine Copepoda of the Boulonnais, not yet completed (see 'Annals' for September 1888 and January 1889), and M. Bonnier's important memoir on the Galatheidæ of the French coasts ('Annals,' July 1888).

Of systematic articles of a more purely descriptive nature attention may be called particularly to a most valuable contribution by M. E. L. Trouessart and M. G. Neumann upon the plumicolous Sarcoptidæ, issued in continuation of a paper published in 1886 in the 'Bulletin de la Société d'études scientifiques d'Angers.' In this paper, which occupies fifty-six pages and is illustrated with six plates, M. Trouessart describes a great number of those curious parasitic mites which inhabit the plumage of birds—objects small and apparently contemptible in themselves, but presenting the most singular varieties of adaptive structure.

M. Bétencourt's list of the hydroid polyps of the Pas de Calais, although only a list with remarks upon the mode of occurrence &c. of the species, is a valuable contribution to our knowledge, and will be particularly interesting to British naturalists; and the same observations apply to Dr. Sauvage's "Catalogue of the Fishes of the Coast of the Boulonnais," reprinted from the 'Bulletin de la Société Zoologique de France,' but supplemented with numerous notes by M. Giard. In like manner M. Giard's notice of the faunistic work done during the year 1888 at the Laboratory of Wimereux contains a quantity of interesting matter in connexion with the distribution and mode of occurrence of numerous species of animals, including many which are of interest to us as inhabitants of our own coasts.

M. Giard's article on Parasitic Castration contains some new points observed by himself, and, further, a discussion of the observations of Mr. Fewkes on the castration of *Amphiura squamata* by a Copepod Crustacean parasite. M. Giard notices further the castration of this species at Wimereux by Orthonectida; and he concludes his article with a series of numbered "theses," giving an aphoristic definition of the phenomena included under the term "parasitic castration." We find further notices upon this and other matters of biological interest, both zoological and botanical, in the articles contributed by M. Giard under the title of "Fragments biologiques." Two or three extracted and translated articles are also of much interest from the point of view of general biology. Among these we may notice translations of papers by MM. Weismann and Ischikawa on partial fecundation, one by M. Huth on developmental convergence in the animal and vegetable kingdoms, and an abstract by M. Giard of a memoir by M. Maurice Hovelacque on the vegetative apparatus of the Bignoniaceæ, Rhinanthaceæ, Orobanchææ, and Utriculariæ, furnishing a very remarkable indication of the singular adaptations which the members of a group may undergo to suit them to very different conditions of existence.

A very curious paper from a Russian source is that by M. J. Krassiltschik on "The industrial production of vegetable parasites for the destruction of injurious insects." In this the author notices

the well-known fact that great numbers of insects, injurious and otherwise, are constantly being destroyed by the action of parasitic Fungi, the mode of operation of which he describes very clearly, and he refers to various naturalists who entertained the notion that something might be done for the destruction of insects injurious to agriculture by favouring the propagation of these insidious enemies. The first who attempted to realize this idea appears to have been the Russian naturalist Metschnikoff, and on his being prevented by other work from continuing his researches in this direction M. Krassilstezhik undertook to carry on the work. He notices the difficulties which stand in the way of the successful prosecution of this curious cultivation, and indicates, but only in general terms, how these were overcome, so that he is able to estimate that the quantity of spores of at all events one species, *Isaria destructor*, which is particularly destructive to *Cleonus punctiventris*, itself a special enemy of the beetle, necessary for the infection of 1 hectare (=about $2\frac{1}{2}$ acres) will cost only 10 francs. The spores are spread over the fields either along with the manure or mixed with sand, and in experimental "sowings" of this kind very distinct epidemics of the parasites were produced, amounting in ten days or a fortnight to from 55 to 80 per cent. of the insects.

In Palæontology we find an important note by M. Dollo on the cranium of the Mosasauridae, illustrated with several woodcuts of parts of the skull and with a large plate containing figures of the crania of *Mosasaurus* and *Hainosaurus*, and, further, an article by the same author on the signification of the pendent trochanter in Dinosaurs.

Of course in a notice such as this it is impossible either to enumerate all the articles contained in the volume or to give more than a passing reference to those which are mentioned, and with the exception of M. Krassilstezhik's paper we have done little more than indicate the titles. Nevertheless we hope that we have said enough to show that the 'Bulletin Scientifique' in its new form promises to play an important part in the advancement of Natural History, and that the reader may expect to find throughout its pages much sound and useful information.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

March 20, 1889.—W. T. Blanford, LL.D., F.R.S.,
President, in the Chair.

The following communication was read:—

"Note on the Pelvis of *Ornithopsis*." By Prof. H. G. Seeley, F.R.S., F.G.S.

The remains preserved in Mr. Leeds's collection at Eyebury, and described by Mr. Hulke, are the largest and most perfect pelvic

bones of a Saurischian known in this country. An examination showed that the bones of the right and left sides were united in the median line almost throughout their length by a median suture, and that they formed a saddle-shaped surface internally from front to back. After giving a detailed description of the pubis and ischium, the Author stated that he was not aware that this type of pelvis had been previously observed. He noted that the antero-posterior concavity between the anterior symphysis of the pubic bones and the posterior symphysis of the ischia was a well-marked characteristic of Saurischian reptiles, but that it remained to be determined to what extent the median union of the pubic bones was developed in the group.

It was impossible to judge of the form of the ilium from the imperfect fragment preserved, but it did not make any recognizable approximation to the bone in those American genera which offered the closest resemblance of form to the pubis and ischium.

There were several minor differences of proportion between the bones from the Oxford Clay and those from the Wealden of the Isle of Wight, and the former differed in ways pointed out from *Morosaurus*, *Diplodocus*, and *Brontosaurus*, though there were resemblances.

April 3, 1889.—W. T. Blanford, LL.D., F.R.S.,
President, in the Chair.

The following communications were read :—

1. "The Basals of *Eugeniocrinidæ*." By F. A. Bather, Esq., B.A., F.G.S.

Although Professors Beyrich and v. Zittel had alluded to certain specimens of *Eugeniocrinus* as proving, by the course of the axial canals, that in this genus the basals had passed up into the radials, yet the two chief authorities who subsequently discussed the subject practically ignored this argument. M. de Loriol contented himself with denying any trace of basals, while Dr. P. H. Carpenter maintained that the top stem-joint represented a fused basal ring. In a previous paper the Author had argued in favour of Prof. v. Zittel's view without convincing Dr. Carpenter of its correctness. Such scepticism was, no doubt, warranted by the lack of detailed description and of figures. The object of the present note was to set the matter at rest by describing and figuring certain dorsal cups of *Eug. caryophyllatus* kindly lent to the Author by Prof. von Zittel.

Owing to the mode of fossilization the canal-system is plainly seen. The axial canal passes up into the radial circle and gradually widens; at a short distance below the floor of the calycal cavity it gives off five interrarial branches; these soon bifurcate, and the adjacent radial branches converge. Before they meet, each radial branch gives off a very short branch; this connects the radial branch with the ring-canal that contained the interrarial and intrararial commissures.

The evidence of all other crinoids that have these canals shows that the basals always contain the interrarial branches. And in *Eugeniocrinus*, since the interrarial branches have their origin in the middle of the radials, the basals must have passed up in between the radials.

2. "On some Polyzoa from the Inferior Oolite of Shipton Gorge, Dorset." By E. A. Walford, Esq., F.G.S.

The Author referred to the little attention the Jurassic Polyzoa have received in England, a few scattered papers comprising the whole of the literature of the subject. This may be accounted for, in part, by the rare occurrence of conditions favourable to the preservation of the delicate features necessary for their true study, and in part, also, by the difficulties into which the classification has drifted.

The series dealt with has been collected from the Inferior Oolite, zone of *Ammonites Parkinsoni*, at Shipton Gorge, Dorset, and the number of forms from the single horizon and locality was stated to be equal to the whole of those described by Jules Haime from the Lias to the Kimmeridge Clay. Associated with the Polyzoa are *Crania Moorei* and sp., *Thecidea*, sp., *Rhynchonella senticosa*, *Terebratula Phillipsii*, *Ammonites Martinsii*, some Echinoderms, and a large series of sponges. The tranquil conditions prevailing during the deposition of the beds are indicated by the presence of many slender and arborescent forms of Polyzoa, and the little abrasion they have suffered, as well as by the numerous sponges.

The Author, in briefly reviewing the Cyclostomata, adopts the simple divisions of Mr. Waters, the Parallelata and Rectangulata, based upon the Hincksian system. The disregard of zoarial growth, in any great degree, as a means of classification, would lead to confusion under the present modes of grouping; neither, however, can any great constancy be found in the form of the zoœcia or in the shape of the aperture.

In the group *Stomatopora* six species are recognized, of which two are new. Amongst the *Proboscine* is a species described in that stage of growth as *Proboscina spatiosa*, which passes into both Tubuliporoid and Diastoporoid forms, and also in the latter phase throws off erect Entalophoroid branches. The Author has used the same specific name for each form, though describing them under different generic names. Considerable variation in size and shape of cell occurs in each stage. The *Idmonæe* are represented by two new species and two new varieties; *Bisidmonæa* by one form only. Though the latter has much the appearance of *Entalophora* the character of the ovicell is so definitely that of the associated *Idmonæa* as to decide its relationship, and it has also the cell-type of *Idmonæa*. In the group *Entalophora* d'Orbigny's Cretaceous species *Entalophora raripora* and *E. subgracilis* are quoted, the latter, however, under a varietal form. *E. anomala*, Manz., *E. richmondensis*, Vine, and one new species, *E. magnipora*, complete the list so far.

MISCELLANEOUS.

Results of recent Investigations upon the Organization of the Nebaliæ and the Systematic Position of the Leptostraca. By Prof. C. CLAUS.

AMONG the *Nebaliæ* belonging to the same species we have to distinguish the following forms: (a) sexually mature males, recognizable by the slender, elongated form of the body, the long furcal joints, tufted flagella on the anterior antennæ, and much elongated flagella on the second pair of antennæ; (b) pregnant females, with fans of setæ on the terminal joints of each thoracic limb; (c) sexually mature females and younger females of different sizes, with a coating of short setæ upon the terminal joints of the thoracic limbs; (d) young males of different sizes, recognizable by the shortly annulated flagellar joints of the second antennæ; and (e) larvæ with three-jointed antennal flagella and the fourth pair of pleopoda still simple.

The northern form, described as *N. bipes*, O. Fabr., is a variety, distinguished by the greater dimensions of its body and the richer articulations of its antennal flagella, of the Adriatic, Mediterranean, and Atlantic *Nebalia*, to which the *Nebalia* of the east coast of North America also belong. The *Nebalia* of the coasts of Chili and Japan (as also the New-Zealand species described as *N. longicornis*) present such small and unimportant peculiarities that they may more properly be regarded as varieties of the same species than as distinct species.

The so-called rostral plate represents a third piece of the carapace, movably separated as a cephalic flap, which covers two rostral processes of the head, and is so connected with these that, when the head is raised, the cephalic flap of the carapace is lifted at the same time.

The last two segments of the abdomen, together with the Branchipodiform furca, represent the telson of the Malacostraca, with which they also have in common the *ventral* position of the anal fissure (on the terminal segment).

The complex structure of the cerebrum, which far exceeds that of the Phyllopod cerebrum, like the intimate structure of the eye-ganglion, indicates affinity to the Malacostraca. The middle-brain, with the centres of the olfactory nerves, agrees in the presence of the so-called "glomeruli olfactorii" with the "lobi olfactorii" of the Isopoda and Podophthalma. The hind-brain (ganglion of the second pair of antennæ) lies on the œsophageal commissure, and possesses a slight subœsophageal transverse commissure, which is separated from the commissure of the mandibular ganglion. The mandibular and maxillary ganglia are well separated (as in *Apseudes* and *Sphæroma*), as are also the eight ganglia of the thoracic segments. In the embryo and larva behind the six abdominal ganglia a seventh ganglion is recognizable; this afterwards becomes retrograde and disappears.

On the mesial side of the pedunculated eye there is, beneath two tubercles, a special sense-organ of unknown function (frontal organ?). The minute structure of the *faceted* eye and its ganglion comes nearest to that of the Mysidæ.

The terminal section of the buccal intestine is, as in the Malacostraca, armed with a complex apparatus of chitin-structures, converting it into a gizzard; this apparatus consists of two cardiac jaws, a band of setæ on the right side, two pairs of pyloric plates beset with setæ, and a funnel-groove extending far into the intestine. The liver consists of two anterior sacs projecting into the head, and of three pairs of tubular sacs extending backwards as far as the last abdominal segment. The middle intestine and posterior hepatic sacs are imbedded in a perivisceral mass of connective tissue, which also surrounds the sexual glands, the cells of which are filled with fat-globules, and are of great importance in the regulation of the nourishment at the time of the cessation of feeding. Pregnant females and sexually mature males gradually use up the nutriment deposited in this tissue, so that, finally, after the disappearance of the fat-globules, the perienteric cell-cord completely shrivels up, while the blood-spaces of the body-cavity appear enlarged in the same proportion. At the end of the middle intestines opens an unpaired cæcum situated above the rectum, the cell-covering of which is continued far forward on the dorsal wall of the intestine.

Besides the *antennal gland* a small *shell-gland*, reduced almost completely to the terminal saccule, is present, in which, as in the terminal sac of the former, carmine-granules accumulate, after feeding with carmine. The missing looped ducts are replaced by *eight pairs of pedal glands*, which are coloured blue after feeding with indigo-carmine.

The heart extends from the maxillar region through the whole middle-body into the fourth segment of the abdomen, and is perforated by seven pairs of ostia, the fourth, fifth, and sixth of which are small fissures placed on the dorsal surface, while the rest pertain to the right and left lateral surfaces. Besides an anterior and a posterior aorta there are ramified arteries in the abdomen and in both pairs of antennæ.

The efferent ducts of the sexual glands resemble those of the Malacostraca both in position and in their mode of opening. The females carry their eggs and young, like the Arthrostraca and other Podophthalma, on the pectoral surface of the middle-body between the lamellar pairs of limbs and their fans of setæ, as in a basket through which the water flows, and they also harbour the hatched and moulting larvæ for a considerable time in this brood-chamber.

The Leptostraca are to be regarded as the first main division of the Malacostraca.

The fossil Ceratiocaridæ, together with allied palæozoic genera of Crustacea, judging from their possession of movable cephalic flaps, belong to the same developmental series as the Leptostraca, but cannot be united in the same order with them, as the organization

and the structure of the parts of the mouth and the limbs, as well as the relative number of the segments, may have been very different (leaving quite out of consideration the very different form of the extremity of the abdomen).—*Anzeiger d. k. Akad. Wiss. Wien*, December 13, 1888, p. 247.

On the Formation of the Antherozooids of the Characeæ.

By M. LÉON GUIGNARD.

The antherozooids of the Characeæ, Muscinæ, and vascular Cryptogamia have the form of a spiral filament furnished with cilia, originating by special metamorphosis of the contents of the mother-cell. In its formation the nucleus of the mother-cell plays an essential part; it does not dissolve, as was at first supposed, but concurs directly in furnishing the body of the antherozoid, while the cilia proceed solely from the protoplasm.

But is the body of the antherozoid solely derived from the nucleus or both from the nucleus and the protoplasm? If it is furnished by the nucleus alone, nourished by all the portion of the protoplasm which is not employed in the formation of the cilia, how is this metamorphosis effected? If, on the contrary, the protoplasm furnishes a portion of the body, does the differentiation of the spiral filament commence at the expense of the protoplasm and not of the nucleus, as has recently been asserted? Lastly, how and at what moment do the cilia originate? These are so many general questions upon which the extant data are insufficient or contradictory.

By a comparative study of the various groups of Cryptogamia the author has been enabled to clear up the doubtful points, and has arrived at results the agreement and generality of which render them interesting. In the present note he deals with the Characeæ.

In these plants the antheridian filaments are formed of superposed discoidal joints, which represent the mother-cells of the antherozooids. To ascertain the parts played by the nucleus and protoplasm in the formation of the latter these cells must be dissociated and their contents carefully isolated after fixation and hardening. By various methods of double coloration the substance of the nucleus may be very clearly distinguished from that of the protoplasm, and all stages of the development may be followed step by step.

At the moment when the antherozoid is about to originate the nucleus moves to the side of the mother-cell, so that its outer surface is only covered by a very thin layer of hyaline protoplasm. On this outer surface a small thickening-band afterwards appears, more refractive than the rest of the nucleus which produces it by a special metamorphosis of its substance. This band forms part of the nucleus without producing a salient crest on its outer surface, and following its contour it resembles a short and very open crescent.

One of its extremities soon becomes elongated and touches on the surface of the protoplasm; the nucleus then seems to be provided with a sort of beak, which is really the anterior extremity of the body of the antherozoids.

When this sketch of the body appears the two cilia with which it will be provided are differentiated close to the anterior extremity in the thin layer of hyaline protoplasm which covered the outer surface of the nucleus, and which, to form them, is continued all round the granular protoplasm situated at the inner surface. They at once acquire their definitive length, which is equal to that of the adult body. Soon after their formation they become detached from the granular protoplasm and separate more or less from each other in the free space situated between the wall of the mother-cell and the contents.

While the anterior extremity of the antherozoid begins to turn round the surface of the granular protoplasm the posterior extremity, by the elongation of the thickening-band, grows in the opposite direction and soon becomes juxtaposed with the former, giving a first turn of the spiral. The nucleus then shows a progressive diminution of volume and becomes more and more homogeneous; then, the growth continuing, it becomes gradually stretched between the two extremities of the body, so that the swelling which it formed in the course of the elongating spiral disappears when the latter includes about two turns.

During this time the protoplasm is insensibly digested and employed in the nutrition of the antherozoid. Much reduced towards the end of the development it adheres only to the inner surface of the posterior extremity of the body; and when the latter has reached its full length it disappears without leaving a vesicle, as in other Cryptogamia. Nevertheless, even in the adult stage the antherozoid still presents some protoplasmic granules upon this inner face of its posterior extremity. It then forms (*e. g.* in *Chara fragilis*) rather more than three turns of the spiral. It presents all the reactions of nucleine, and on its surface there is an excessively thin hyaline envelope.

Thus, from the morphological point of view, it is the nucleus, and the nucleus alone, that is directly transformed, without breaking up into a spiral, to form the body of the antherozoid, the formation of which therefore does not commence in the protoplasm. The cilia are indeed of protoplasmic origin; carried on by the anterior extremity upon which they are inserted, they must necessarily acquire their definitive length from the first phase of development.—*Comptes Rendus*, January 7, 1889, p. 71.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 18. JUNE 1889.

LIV.—*Notes on British Amphipoda.*—I. *Megaluropus*, *n. g.*,
and some *Ædiceridæ*. By the Rev. A. M. NORMAN,
M.A., D.C.L., F.L.S.

[Plates XVIII.-XX.]

My purpose in these notes is to describe new or little-known Amphipoda, to correct nomenclature, and to give details regarding distribution.

At the time when Messrs. Bate and Westwood's 'History of British Sessile-eyed Crustacea' was published the subject, more especially as regards the Amphipoda, had been little studied. Sexual differences had scarcely been recognized, and still less the alterations of structure dependent upon age; hence many errors crept in. But a more serious obstacle to the full and accurate description of the forms was the scarcity of specimens at the disposal of the authors for examination. In a large number of instances species were described from single individuals which, having been merely entrusted to the authors for examination, they were unable to dissect; moreover in some instances these specimens were dried, and presented therefore the greatest difficulties with respect to their full elucidation. It is only by dissecting and mounting the organs of the Amphipoda that their structure can be fully and properly

seen. I have thought it only right to draw attention to these points, since I am compelled frequently to dissent from the conclusions of Messrs. Bate and Westwood in these notes.

Genus *MEGALUROPUS*, n. g.

(μέγας, οὐρά, ποῦς=having large uropods.)

Head produced forwards between the bases of the antennules and antennæ into a conspicuous lobe in which the large round eye is situated. Antennules with short secondary flagellum, much shorter than the antennæ. Gnathopods not large, subchelate, second pair rather larger than the first. Last uropods with the branches in the form of large, membranaceous, leaf-like laminae. Telson squamiform, cleft to the base.

The most remarkable characters in this genus are the eye, which is situated on the greatly projected lobe, and the expanded foliaceous branches of the last uropods. In the former particular we are reminded of the genus *Photis* (= *Eiscladus*, B. & W.), in the latter of the genus *Elasmopus* (Boeck), near to which last genus the present should, I think, take its place. In *Elasmopus* the eye is situated on the side of the head, the antennules are longer than the antennæ instead of the reverse, and the peræopods are constructed in a very different manner, the joints being widely expanded and the limbs robust.

Megaluropus agilis, n. sp. (Pl. XVIII. figs. 1-10.)

Head (fig. 1) with a rostrate acute process above, which is extended about half the length of the first joint of the antennules; on the side between the bases of the antennules and antennæ there is projected a large lobe, which is pointed at the end and reaches one third of the length of the second joint of the peduncle of the antennules; this lobe, with the exception of the point at its extremity, is filled with an eye composed of large conspicuous lenses. Antennules slender, first two joints subequal in length, third about half that length; flagellum shorter than peduncle, composed of six or seven articulations, secondary appendage minute, consisting of two articulations. Antennæ having the two distal joints of the peduncle subequal, very long and slender and almost naked; flagellum eight-jointed. First gnathopods (fig. 2) having the wrist ovate, as long as and broader than the ovate hand, which latter tapers towards the extremity, the whole of which is occupied by the attachment of the strong, well-curved nail; palm continuous with the front margin for nearly two

thirds its length. Second gnathopods (fig. 3) somewhat stronger than the first; wrist triangular, widening to the extremity, and forming a conspicuous lobe below the attachment of the hand, this lobe terminating in several spine-like setae; hand nearly straight on the back and convexly rounded below, the length double the greatest breadth, which is nearly central; finger long and well curved, an undefined palm to about half the length of the hand. Last pereopods (figs. 5 and 5 a) very long and slender, when stretched backwards reaching beyond the uropods; basos oblong and produced behind into a downward directed lobe, and reaching much below the extremity of the ischium; terminal joints very slender, the last without a nail, ending in setae. First uropods (fig. 6) with branches shorter than the peduncle, upper edge of outer branch spinose and finely serrated on the edge between the spinules. Last uropods (fig. 7) consisting of a strong basal joint and two leaf-like, broad, membranaceous branches, widely rounded at the extremities, and with the margin there obscurely crenulated, with minute cilia in the interstices of the crenulations. Telson (fig. 8) in form as two thirds of an ellipse, cleft to the base, a row of minute cilia within the margin. Hinder dorsal margin of third segment of pleon serrated and hinder lateral margin of the same segment also serrated, the serrations on the lower portion (fig. 10) set in pairs or threes with a sinus between, and at the bottom of each of the sinuses there is a cilium. Infero-posteal angle of second segment of pleon also produced to a spine-point, above which there are commonly one or two serrations. Length 4-5 millim.

This species is most frequently taken by means of the surface-net at night, it being a very active swimmer.

Hab. Cumbræ, Firth of Clyde (*D. Robertson*); Starcross, Devon; and Jersey (*A. M. N.*); 25 miles off May Island, Firth of Forth (*John Murray*): *Mus. Norm.* Liverpool Bay! (*A. O. Walker*).

Fam. *Ædiceridæ*.

Genus I. *MONOCULODES*, Stimpson.

1. *Monoculodes carinatus*, Bate. (Pl. XIX. figs. 1-5.)

1855. *Westwoodia carinata*, Bate, Brit. Assoc. Rep. p. 58.

1859. *Ædiceros affinis*, Bruzelius, Skand. Amphip., Gammaridæ, p. 93, pl. iv. fig. 15, ♂ junior.

1862. *Monoculodes carinatus*, Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 165 (♂ ?).

1862. *Monoculodes Stimpsoni*, iid. ib. p. 160, ♂ junior.

1870. *Monoculodes affinis*, Boeck, Crust. Amphip. bor. et aret. p. 84, ♀.

1876. *Monoculodes affinis*, Boeck, De Skand. og Arkt. Amphip. p. 265, pl. xiv. fig. 6, ♀.

1883. *Monoculodes carinatus*, Schneider, Af Norges kyster forekom. Art. af CEdiceridæ, p. 19, pl. i. fig. 4.

1887. *Monoculodes carinatus*, Chevreux, Cat. Amphip. du Sud-ouest de la Bretagne, p. 12.

Hab. Shetland, Cumbræ, Firth of Clyde, Northumberland coast (*A. M. N.*); Banff (*T. Edward*); 25 miles off May Island, in the Firth of Forth (*John Murray*): *Mus. Norm.*

Distribution. Florö, Norway, 35 fath. (*A. M. N.*); South and West Norway (*G. O. Sars*); Bohuslän (*Bruzélius*); Croisic, France (*Chevreux*).

Adult female. Rostrum (fig. 1) largely hooded, equal to length of first joint of antennules, extremity bent downwards, rather blunt; eye large, occupying the greater part of the rostrum. Antennules with second joint equalling first, the third not half the length of the second. Antennæ with fifth joint about one third longer than fourth. First gnathopods (fig. 2) having the wrist short, calx half the length of hand, broadly linguiform, broadest in the middle, widely rounded at the extremity, hollowed on the face towards the palm, setose all over; hand ovate, palm well arched, occupying one half the margin, the strongly curved finger reaching nearly to extremity of calx of wrist. Second gnathopods (fig. 3) having the wrist produced into a very long, narrow, linear calx, which is appressed to the margin of the hand, the length of which it slightly exceeds; hand in the form of a long oblong, with parallel sides, which are not arched, rather more than three times as long as broad, palm scarcely at all oblique, occupying the distal side of the oblong. Peræopods 1-4 remarkable on account of their terminal joints, densely clothed with setæ and slender spines, and the characters of the hand, which is densely setose on one margin and furnished within the other with a row of minute spinules, and of the nail, which is very minute and weak; the fourth pair (which is figured, fig. 4) is not so densely setose and spinulose as the first and second pairs, and the nail is somewhat larger. Last peræopods (fig. 5) having the basal joint subquadrate, length and breadth subequal, front margin bearing spinules, hinder margin ciliated, and a few long plumose setæ spring from the face; four distal joints subequal in length. Length 10 millim.

The male differs from the female in having the second and third joints of antennules much shorter and the flagellum much thickened, the first articulation very long, and densely clothed with setæ. The antennæ have the upper margin of the distal joints of peduncle set with transverse rows of minute cilia, the flagellum greatly elongated, consisting of 70-80 articula-

tions. These sexual distinctions in the male seem to hold good throughout the genus, as I have noticed them in several species. The last peræopods, moreover, instead of having the two distal joints furnished with small spinules and groups of 3-5 and of single, long, spine-like setæ, have the penultimate joint more strongly spined and the last more slender, the spines stronger, and the setæ of much greater length.

In the young (May Island) the antennæ are less strongly spined and the brush of setæ of the hand of peræopod much less developed proportionately than in the adult.

Bate and Westwood's figure and description of *M. carinatus* are inexact in the following points:—The metacarpus of the first gnathopods is not "produced inferiorly to a sharp point," but is obtusely produced and furnished with numerous divergent setæ at the extremity. In the figure the lower margin of the last joint of the antennæ is represented as clothed with down, which is not the case in the female, in which it has transverse rows of spines, and although the male has such down (or cilia) it is on the upper, not lower, margin. The last joints of last peræopods are also drawn too setose for the female, though the last joint would well represent that part of the male. Judging from the *antennæ*, however, I should suppose that Bate and Westwood's figure was taken from a female.

Monoculodes Stimpsoni was first described in Cat. Amphip. Crust. Brit. Mus. p. 105, from a very imperfect specimen; but, in Hist. Brit. Sessile-eyed Crust., Bate and Westwood made a specimen in my collection their type. That specimen I have now dissected and compared carefully with *M. carinatus*, to which it is undoubtedly referable. It will be observed that their figure and description of the antennæ do not accord, while the figure and description of the second gnathopods are altogether wrong, the mistake having clearly arisen from a laterally foreshortened view of the limb in the undissected animal. The numerous short joints of the flagellum of the antennæ show it to be an immature male and is the state which exactly accords with *M. affinis*, Bruzelius.

Monoculodes affinis of Goës, however, is certainly not this species, and he appears, moreover, to have confused two species. One of these (Goës, fig. 21') Schneider assigns to *M. borealis*, Boeck, and the other (Goës, fig. 21) with doubt to *M. norvegicus*, Boeck. Hansen agrees as to the former allocation, which appears to me also to be correct, but would refer the latter to *M. tuberculatus*, Boeck.

Hansen ('Malacostraca marina Grœnlandiæ occidentalis,'

1887, p. 108, pl. iv. fig. 5) has recently described a species from Greenland, *M. crassirostris*, which has similar small nails to *M. carinatus* and chiefly seems to differ from that species in the fact that the basal joint of the last peræopods is more dilated. Is it really distinct?

2. *Monoculodes subnudus*, n. sp.
(Pl. XVIII. fig. 11, and Pl. XIX. figs. 6-10.)

Rostrum (fig. 6) well developed, arcuate, apex acute, bent downwards and extending considerably beyond first joint of antennules. Eye large, occupying the basal portion of rostrum, not prominent. Antennules with basal joint furnished with plumed setæ and spines; second joint equal in length to first, third half the length of second; flagellum of 11-14 long joints. Antennæ having fourth and fifth joints subequal. First gnathopods (fig. 7) having the thigh long; calx of carpus elongated ovate, divergent, reaching commencement of palm; hand narrow at the base and expanding distally, arcuate, arched* on the back, distinctly concave in front, widest at the commencement of the palm; palm scarcely occupying one half the length of the hand. Second gnathopods (fig. 8) in general form as in *M. borealis*, but having the hand much narrower in proportion to its length, length about equal to five times the breadth, palm oblique, occupying somewhat less than one third of length; calx of wrist linear, somewhat divergent, reaching commencement of palm. First and second peræopods (Pl. XVIII. fig. 11) with length of joints in the following order:—thigh, meros, hand, wrist, nail, ischium; sparingly ciliated except wrist; thigh linear, five times as long as broad, as usual with stiff setæ on parts of the margin, and a few plumose setæ on the face; meros nearly linear, not lobed behind, upper margin naked, except a small bunch of (6-8) setæ at distal extremity; wrist densely ciliated in front and produced there downwards into a little lobe; nail well developed, slightly curved, equal in length to two thirds of the linear hand. Third and fourth peræopods (fig. 9) with thigh, metacarpus, and hand subequal in length, wrist rather shorter, nail well developed, nearly straight, more than half the length of long linear hand; thigh ovate, flattened into a thin plate behind and slightly so on edge in front, girt with stiff simple setæ and numerous plumose setæ on face; meta-

* I regard all the limbs of the body (whether directed forwards or backwards) as I do a human hand; that is, the back or upper side is that away from the bend of the limb, the front or lower side that which is within the bend of the member.

carpus rather expanded and lobed behind, the lobe not projected downwards over wrist; wrist and hand linear, all the joints except thigh only sparingly setose. Last peræopods (fig. 10) with thigh pyriform, as broad as long, slightly emarginate below behind. All the pairs of uropods with inner branch somewhat longer than outer, last pair with peduncle and longer branch subequal. Telson subquadrate, apex emarginate in the centre, angles broadly rounded, each furnished with five marginal spinules. Length 10 millim.

The male differs from the above-described female in having the second and third joints of peduncle of antennules shorter (as appears to be usual in males of this genus) and together not equalling the length of first joint; flagellum long, 15-jointed, joints very long, especially the first and the distal articulations, first equalling combined length of last two joints of peduncle, densely setose. Antennæ with two distal joints of peduncle clothed with short cilia on upper margin; flagellum very long.

Monoculodes subnudus is distinguished from its allies more especially by the rostrum, telson, and peræopods; the name *subnudus* has allusion to the comparatively slight ciliation of the last-named organs in this species.

Hab. Shetland; Sleat Sound, Isle of Skye (*A. M. N.*).

In many respects *M. subnudus* approaches *M. borealis*, Boeck, but may at once be distinguished by the greater length of the rostrum and its less arched form; a figure of the rostrum of *M. borealis* is given for comparison (Pl. XIX. fig. 11). It also comes near to the Greenland species *M. simplex*, Hansen, but here again the longer rostrum suffices to distinguish it. The form of the rostrum appears to afford very valid characters in this genus, and all the specimens of the present species which I have examined have the rostrum alike.

3. *Monoculodes longimanus*, Bate and Westwood.

(Pl. XX. figs. 6-9.)

1868. *Monoculodes longimanus*, Bate & Westw. Brit. Sessile-eyed Crust. vol. ii. p. 507.

1870. *Monoculodes Grubei*, Boeck, Crust. Amphip. bor. et arct. p. 85.

1876. *Monoculodes Grubei*, Boeck, De Skand. og Arkt. Amphip. p. 269, pl. xvi. fig. 1.

1883. *Monoculodes Grubei*, Schneider, Af Norges kyster forekom. (Ædiceridæ, p. 24.

1887. *Monoculodes longimanus*, Chevreux, Cat. Crust. Amphip. du Sud-ouest de la Bretagne, p. 13, pl. v. figs. 1, 2.

1888. *Monoculodes equimanus* (Norman, MS.), Robertson, Contrib. Cat. Amphipoda and Isopoda Firth of Clyde, p. 26.

Hab. Oban; Firth of Clyde; Starcross, Devon (*A. M. N.*);

Banff (*T. Edward*): *Mus. Norm.* Off the Scilly Islands (*D. Robertson and G. S. Brady*).

Distribution. Southern Norway (*G. O. Sars*): *Mus. Norm.* South-west France (*Chevreaux*).

Animal white, pellucid. Rostrum (fig. 6) very short, not hooded, extremity blunt, closely appressed to first joint of antennules, and not equal to half its length. Eye very large and of unusual form in the genus, situated at base of rostrum, and extending thence down the side of the head round the base of the antennules, its colour brilliant blood-red, lenses indistinct. Antennules (♀) with peduncle much longer than that of antennæ, first joint rather more than twice as long as broad, second joint longer, third still longer and very slender; flagellum about six-jointed. Antennæ with last two joints of peduncle short and subequal. Gnathopods (figs. 7 and 8) of nearly the same form in both pair; no produced calx to meros; wrist produced into a long linear calx, projected forward parallel with the hand, and in the first pair extending markedly beyond the commencement of the palm, in second pair longer still and exceeding in length the whole hand; hand greatly elongated, gently arched above in the first, nearly straight in second; length in second pair about five times the breadth, palm moderately oblique; basos of second pair much longer than that of first, the whole limb being more produced. Anterior peræopods with broad hand, the little nail, which is not half its length, attached at lower corner of the extremity, and from above it springs a dense brush of long setæ. Last peræopods (fig. 9) very long, extending greatly beyond the uropods, four last joints subequal, the nail being exceedingly long and slender. Telson obovate, widely rounded at the extremity. Length 3-4 millim.

Chevreaux has accurately figured the heads of the two sexes. The male differs from the female in having the last two joints of the peduncle of the antennules shorter than the first joint and the first articulation of the flagellum greatly developed, very long, and densely ciliated, while the antennæ have not the upper margin of two distal joints of peduncle covered with minute cilia (as is usual in males of this genus), but the flagellum is, as usual, greatly elongated.

My friend Mr. Robertson and myself have taken the males of this species by means of the tow-net worked at night.

Mr. D. Robertson has given in his excellent 'Catalogue of the Amphipoda and Isopoda of the Firth of Clyde' the name *Monoculodes aquimanus*, Norman MS., a name by which I distinguished this species in my collection and which I gave him before it was described by Bate and Westwood.

4. *Monoculodes Packardi*, Boeck.

1870. *Monoculodes Packardi*, A. Boeck, Crust. Amphip. bor. et arct. p. 86.

1876. *Monoculodes Packardi*, A. Boeck, De Skand. og Arkt. Amphip. p. 274, pl. xiv. fig. 3.

1883. *Monoculodes Packardi*, Schneider, Af Norges kyster forekom. art. af *Ædiceridæ*, p. 27, pl. i. fig. 6.

Hab. Loch Striven, Firth of Clyde, 40 fathoms, dredged by the 'Medusa,' the steamer of the Scotch Marine Station (*David Robertson*): *Mus. Norm.*

Distribution. Tromsø, 20 fathoms (*S. Schneider*): *Mus. Norm.* South and West Norway (*G. O. Sars*).

Mr. D. Robertson brought this species under my notice last summer, when he also kindly gave me specimens. It is not here described because I believe that he will himself shortly do so. It may be mentioned, however, that I have confirmed his identification by actual comparison of his specimens with those kindly given me by Herr J. Sparre Schneider from Tromsø, with which specimens the Clyde examples entirely agree.

5. *Monoculodes æquicornis*, Norman. (Pl. XX. figs. 1-5.)

1868. *Ædicerus æquicornis*, Norman, Last Report Dredging among the Shetland Isles, Brit. Assoc. Report, p. 278.

Rostrum extending beyond the first joints of the antennules. Antennules having the three joints of the peduncle of nearly equal length, each more slender than the preceding, filament equal in length to the last two joints of the peduncle, composed of five long articulations. Antennæ slender and short; peduncle exceeding that of antennules by nearly the last joint, which is equal in length to the penultimate; filament very slender, 4-5-jointed, equal in length to the last joint of the peduncle. First gnathopods (fig. 1) with wrist anteriorly produced into a wide rounded lobe, which reaches forward to the commencement of the palm; hand obovate, widest in the centre, where the palm commences, which is very oblique; finger slender, simple, as long as the palm. Second gnathopods (fig. 2) very like the first, but the hand slightly larger and rather more elongated. All the peræopods with very long and nearly straight nails (fig. 3), which about equal the propodos in length; propodos much longer than carpus. Penultimate peræopods (fig. 4) with a row of setæ down the middle of the basos. Last peræopods (fig. 5) with the basos small, elongated, pear-shaped, equally produced antecally and

posteadly, both margins with small cilia, the hinder margin also crenated, the last four joints all greatly produced and each longer than the basos, the whole limb very long. Length 5 millim.

A single specimen from St. Magnus Bay, Shetland, in 30-60 fathoms (1867).

The above is the description given by me in the 'Shetland Dredging Report.' The specimen, which was mounted, is not now in good condition, the antennæ, antennules, and rostrum having a good deal shrunk and the gnathopods being somewhat folded. For this reason the figures given of the gnathopods are probably not so exactly correct as regards the carpus as could be desired; but the hands are in good position for drawing, and the other illustrations may be regarded as strictly accurate. I give the following additional particulars. The setæ of the peduncles of the antennules and antennæ stand out at nearly right angles, and in this respect remind one of *M. tuberculatus*. The first peræopods (fig. 3) are, as well as the other peræopods, very sparingly ciliated, the nail very long and acute, as long as the propodos. The fourth peræopods have the basos ovate, with a line of setæ down the distal half of the centre, the hinder margin with cilia at regular intervals; the meros is expanded behind at its termination, and is there twice as broad as the portion to which the carpus is united. Meros, propodos, and dactylus subequal in length, carpus about one third shorter. Last peræopods having the basos pyriform, rather longer than broad, equally produced behind and before; hinder margin obscurely crenated, with small cilia, front margin bearing minute spinules; meros as long as basos, distal posterior angle produced downwards into a lobe which is equal in length to the breadth of the carpus. Although there is a corresponding lobe in some other species it is here more largely developed than usual.

This species may possibly be the same as *M. tenuirostratus*, Boeck, but I am unable to determine with certainty. The last uropods are absent in my specimen, and the parts which seem to afford good characters in *M. æquicornis* are not so described by Boeck as to lead with any degree of certainty to identification. At any rate the name here employed, *M. æquicornis*, antedates by two years that of *M. tenuirostratus*, and it would appear to differ from the latter form markedly in the characters of the antennæ and antennules, the less produced rostrum (which, though bearing the same relative length to the first joint of antennules, is shorter, since that joint is shorter), the more expanded meros of fourth peræopods, and other points.

Genus II. HALIMEDON, A. Boeck.

[= *Westwoodia* (partim) and *Westwoodilla*, Bate (erroneously described).]

Mandibles only slightly toothed at the extremity and thick : palp very long, narrow, and curiously curved.

First gnathopods having the wrist as long as or much longer than the ovate hand and slightly dilated at the infero-posteal angle.

Second gnathopods with a very long and narrow wrist, either with or without a small "calx;" hand as long as or shorter than the wrist (*Boeck*).

Halimедon parvimanus (Bate and Westwood).
(Pl. XX. figs. 10-14.)

- 1855. *Westwoodia caecula*, Bate, Rep. Brit. Assoc. p. 58, ♀.
- 1857. *Westwoodia caecula*, Bate, Ann. & Mag. Nat. Hist. ser. 2, vol. xix. p. 139.
- 1862. *Westwoodilla caecula*, Bate, Cat. Amphip. Brit. Mus. p. 102; Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 155, ♀.
- 1862. *Westwoodilla hyalina*, Bate, Cat. Amphip. Brit. Mus. p. 103, pl. xvii. fig. 5, ♂ junior; Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 158.
- 1862. *Ædiceros parvimanus*, Bate & Westw. Brit. Sessile-eyed Crust. vol. i. p. 161.
- 1870. *Halimедon Mülleri*, A. Boeck, Crust. Amphip. bor. et aret. p. 89.
- 1876. *Halimедon Mülleri*, A. Boeck, De Skand. og Arkt. Amphip. p. 281, pl. xiii. fig. 5.
- 1886. *Halimедon Mülleri*, Schneider, Af Norges kyster forekom. art. af fam. Ædiceride, p. 33, pl. iii. fig. 17.

It will be observed that I unite under this name three species described by Bate and Westwood.

The genus *Westwoodilla* was established under a misinterpretation of the form described. The first gnathopods were not observed; the second gnathopods were regarded as the first, and the first pereopods as the second gnathopods. A comparison of the figures published by Bate and Westwood of these parts with those here given will show this to have been the case, while their figures *d* and *g* (p. 155) are good illustrations of the mandible and maxillipeds of *Halimедon parvimanus*, the palp of the mandible of which is very peculiar and unlike that of any other species known to me. With respect to *W. hyalina*, Bate and Westwood themselves questioned its distinctness; it was taken with their *W. caecula*, and I can see no specific character by which it can be distinguished. Their *Ædiceros parvimanus*, of which the types are in my collection, is undoubtedly the *Halimедon Mülleri* of Boeck.

I have felt some hesitation as to which specific name ought to be adopted; but as both *cavcula* and *hyalina* were given under a misapprehension of the structure of the species, and the former cannot moreover be received, as the name implies what is not correct, it has seemed to me best to take the name *parvimanus*, which I the less hesitate to do as Mr. Bate's name will still be associated with the species.

The rostrum (fig. 10) is well developed, gently arched above, and reaches nearly to the end of first joint of antennules; the eye is conspicuous, situated in the rostrum and very prominent; in front of the eye the rostrum is suddenly contracted and projected as a little point; and this peculiar form of the rostrum at once enables the species to be picked out from a gathering of mixed *Ædiceridæ*. The second joint of the antennules in the female is much longer than the first, in the male it is subequal to it in length. The first gnathopods (fig. 11) have the wrist rather longer than the hand, the front margin produced at the middle into a rounded setose lobe, which is not porrected; hand regularly ovate, palm occupying half the length. The second gnathopods (fig. 12) have very much the same character, but the limb is altogether much more slender and drawn out; meros with a little point below; carpus gradually widening from the base to the extremity, distally truncate, and much wider than the insertion of the hand; hand shorter than wrist, ovate, palm occupying fully half its length. The anterior peræopods (fig. 13) have the wrist and hand subequal in length and rather shorter than the meros, the distal half of the back of the hand bears a dense brush of long setæ, the nail well developed and nearly as long as the hand. The nail of the third and fourth peræopods is very long and acute. Basos of last peræopods (fig. 14) widest above, gradually narrowing downwards, length rather greater than breadth. Telson oblong, evenly rounded at the termination, and bearing four spinules. Length 7–11 millim.

As in other *Ædiceridæ*, the male differs from the female in having the last two joints of the peduncle of the antennules shorter and the flagellum densely ciliated almost to the extremity; but the first joint of the flagellum is not elongated and enlarged, as is usual in males of *Monoculodes*. The antennæ have the upper margin of the two distal joints of the peduncle ciliated above and the flagellum of great length.

Hab. Sixty miles east of Shetland, 70–90 fathoms, 1861 (types); St. Magnus Bay, Shetland, 1867; off Durham coast, 1862; Skye, 1866; Cumbræ, 20 fathoms, 1885 (*A. M. N.*); Banff (*T. Edward*): *Mus. Norm.*

Distribution. Florö, Norway, 45–70 fathoms (*A. M. N.*); South and West Norway, 50–200 fathoms (*G. O. Sars*); West Greenland, 25–215 fathoms (*H. J. Hansen*).

There are several closely allied species of *Halimedon* found in Norway, some of which may be expected to occur on our coast.

Genus III. ACEROS, A. Boeck.

Head truncate in front and without any rostrum. “*Eyes* not united, very small, situated on the side of the head” (?). *Epimera* of the third and fourth segments of pereon smaller than in the preceding genera. *Antennules* of female with remarkably long peduncle and very short flagellum, the male peduncle very short and flagellum long. *Mouth-organs* similar in structure to those of the family; the mandibular palp having the second joint curved, but not so strongly as in *Halimedon*, and broader; inner lamina of first maxillæ longer than usual, with three apical plumose setæ. *Gnathopods* small, in general structure as in *Halimedon*, but the wrist furnished with a longer and narrower calx. *Pereopods*, first and second pair with meros long and broad; finger in the form of a long, flattened, knife-like, naked blade; third and fourth pairs short, the nail of similar character to that of preceding pairs; fifth pair long and slender.

Aceros phyllonyx (M. Sars).

- 1858. *Leucothoe phyllonyx*, M. Sars, Oversigt over Norsk-arct. Krebsdyr, Vid. Selsk. Forh. p. 148.
- 1859. *Ædiceros obtusus*, Bruzelius, Skand. Amphip. Gamm. p. 92, pl. iv. fig. 17, ♀.
- 1862. *Ædiceros obtusus*, Bate, Cat. Amphip. Crust. Brit. Mus. p. 373.
- 1862. *Montagua phyllonyx*, id. ibid. p. 369.
- 1865. *Ædiceros obtusus*, Goës, Crust. Amphip. maris Spetsbergiam alluentis, p. 11, pl. xl. fig. 24, ♂.
- 1870. *Aceros phyllonyx*, A. Boeck, Crust. Amphip. bor. et arct. p. 92.
- 1876. *Aceros phyllonyx*, A. Boeck, De Skand. og Arkt. Amphip. p. 392, pl. xiv. fig. 7.
- 1875. *Aceros phyllonyx*, Metzger, Zool. Ergebnisse der Nordseefahrt, p. 282 (no description).
- 1883. *Aceros phyllonyx*, Schneider, Af Norges kyster forekom. (Ædiceridæ, p. 39, pl. iii. fig. 18).
- 1884. *Aceros phyllonyx*, Schneider, Tromsø Museums, Aarshefter, vii. p. 95.
- 1887. *Aceros phyllonyx*, H. J. Hansen, Overs. over det vestlige Grønlands Fauna af Malakostrake Havkrebssdyr, 117, pl. iv. fig. 7.

Head vertically truncate, without the slightest rostrate process. *Antennules* in female with remarkably long peduncle, first joint long, three to four times as long as the

breadth at base, almost naked; second nearly twice as long as the first and longer than combined length of third joint and the flagellum, with a row of long setæ on the edge; third joint shorter than the first; flagellum of about eleven articulations. *Antennæ* longer than the antennules, but the peduncle much shorter, its extremity not nearly reaching the end of the second joint of the antennules; fourth and fifth joints subequal. According to Goës's figure of the male, in that sex the peduncle of the antennules is very short, especially the second and third joint, and it does not reach the end of the penultimate joint of the antennæ, while the flagellum is much longer (about twenty articulations); and the flagellum of the antennæ is, as usual in males, very long. The *gnathopods* are very similar in structure to each other, but the second are longer; the wrist is produced downwards and forwards into a calx, which reaches the commencement of the palm, and is rounded at the extremity, rather more broadly in the first pair than in the second; hand ovate, palm continuous with the front margin and about half its length, finger gently curved. *Pereopods*: in the first pair the thigh is narrow above, rather widening below, much curved; the meros wide, outspread on the back, where it is furnished along the edge with long setæ, as long and as broad as the thigh; wrist and hand subequal in length, each hardly half the length of meros, the former densely setose on the lower margin, and the latter with a group of long setæ at the distal termination of the dorsal margin; finger foliaceous, broadly lanceolate, not quite so long as the hand; second pereopods with finger of similar character to that of first but longer; third and fourth pereopods much shorter and not more than half as long as last pair, the third having the thigh subovate, expanded and well arcuated dorsally, and edged with pectinately arranged long setæ, some of those of the upper margin being beautifully plumose; wrist and hand subequal to each other and their combined length about equal to the meros, the former densely setose below and apically setose dorsally, setæ long; hand setose above, naked below, finger flattened, membranaceous, knife-like, and as long as the hand; fourth pereopods very similar to the third, but the thigh very broad, with numerous long plumose setæ down the centre, but no plumose setæ on the meros. Last pereopods with thigh and meros subequal, the thigh elongated-pyriform, the carpus rather shorter; the propodus is the longest joint and the finger is unguiform, acute, and of moderate length. *Telson* having the length scarcely exceeding the breadth, with arcuate sides and the extremity

as broad as the base of the telson and centrally emarginate. Length 15 millim. or more.

Hab. Sixty miles north of Peterhead, in 69 fathoms, on sandy mud bottom (*Metzger*, who rightly adds "Neu für die brit. Nordseefauna").

Distribution. Greenland, lat. $69^{\circ} 31' N.$, long. $56^{\circ} 1' W.$, 100 fathoms, 'Valorous' Exped. 1865 (*A. M. N.*); Tromsø and Finmark generally (*Schneider*): *Mus. Norm.* Spitzbergen (*Goës*); Siberian Arctic Sea (*Stuxberg*). In Norway it has been found by G. O. Sars at Skraaven in 300 fathoms, and Aalesund in 60-100 fathoms; by Danielssen in the Hardanger Fiord; and by Boeck at Haugesund. In Sweden it has been taken on the Bohuslän coast by Bruzelius; Kara Sea, 55-60 fath. (*H. J. Hansen*, 'Dijmphna'); Barents Sea (*Hoek*, 'Willem-Barents').

This species is added to our fauna on the authority of Metzger, who records a specimen taken at the above-named locality by the 'Pommerania' during the German North-Sea exploring expedition.

Aceros phyllonyx may be distinguished from all other British Cediceridæ by the total absence of rostrum; and also from *Halimedon*, to which it approaches nearest in the form of the gnathopods, by the structure of the antennules.

The figures of Bruzelius of the female are very good and should be consulted.

Herr H. J. Hansen has recently described a very closely allied form from Greenland, *Aceros distinguendus* (*J. H. Hansen*, 'Oversigt over det vestlige Grönlands Fauna af Malakostrake Havkrebssdyr,' 1887, p. 118, pl. iv. fig. 8), and refers to it Goës's pl. xl. fig. 24¹. It is distinguished by the much shorter joints of the antennules and the character of the first peræopods, which are his "pedes tertii," and are thus described:—"Pedes tertii et quarti parium quam in specie præcedente multo latiores; articulus quartus" [*i. e.* meros] "a basi ad apicem versus ante valde dilatatus, articulo sexto perpaulo longior, in latere exteriori setis multis longis in series tres obliquas dispositis ornatus; articulus quintus articulo sexto multo brevior, parte posteriore valde dilatata, angulo infero-posteriore in processum sat magnum, latum, brevior, deorsum vergentem productus; unguis permagnus. Long. maris adulti 5.6 mm.; long. feminae laminis ovigeris instructæ 5.5 mm."

In these Notes on Amphipoda—

Mus. Norm. implies that specimens of the species from *all* the localities

which precede this indication, by whomsoever they may have been found, are in my collection.

(!) implies that I have examined and identified specimens from the locality after which the mark is placed, but that specimens from it are not in my collection.

EXPLANATION OF THE PLATES.

PLATE XVIII.

- Fig.* 1. *Megaluropus agilis*, Norman. Head, showing the peculiar eye.
Fig. 2. The same. First gnathopod.
Fig. 3. The same. Second gnathopod.
Fig. 4. The same. Terminal joints, fourth peræopod.
Fig. 5. The same. Basal joints, last peræopod.
Fig. 5 a. The same. Terminal joints of the same.
Fig. 6. The same. First uropod.
Fig. 7. The same. Telson and last uropod.
Fig. 8. The same. Telson from above.
Fig. 9. The same. Mandible.
Fig. 10. The same. Lower portion of hinder margin of third segment of pleon.
Fig. 11. *Monoculodes subnudus*, Norman. Second peræopod.

[All the figures on the same scale, except 2, 3, and 10, which are more magnified.]

PLATE XIX.

- Fig.* 1. *Monoculodes carinatus*, Bate. Rostrum and base of antennules.
Fig. 2. The same. First gnathopod.
Fig. 3. The same. Second gnathopod.
Fig. 4. The same. Fourth peræopod.
Fig. 5. The same. Basal joints of last peræopod.
Fig. 6. *Monoculodes subnudus*, Norman. Rostrum and peduncle of antennules.
Fig. 7. The same. First gnathopod.
Fig. 8. The same. Second gnathopod.
Fig. 9. The same. Terminal joints of fourth peræopod.
Fig. 10. The same. Basal joints of last peræopod.
Fig. 11. *Monoculodes borealis*, Boeck. Rostrum and base of antennules.

PLATE XX.

- Fig.* 1. *Monoculodes æquicornis*, Norman. First gnathopod.
Fig. 2. The same. Second gnathopod.
Fig. 3. The same. Terminal joints of first peræopod.
Fig. 4. The same. Fourth peræopod.
Fig. 5. The same. Basal joints of last peræopod.
Fig. 6. *Monoculodes longimanus*, Bate & Westwood. Rostrum and first joint of antennules.
Fig. 7. The same. First gnathopod.
Fig. 8. The same. Second gnathopod.
Fig. 9. The same. Basal joints of last peræopod.
Fig. 10. *Halimodon parvimanus*, Bate & Westwood. Rostrum and first joint of antennules.
Fig. 11. The same. First gnathopod.
Fig. 12. The same. Second gnathopod.
Fig. 13. The same. First peræopod.
Fig. 14. The same. Basal joints of last peræopod.

LV.—*Another new Species of Scorpion from Madagascar.*

By R. I. POCK, of the British Museum (Natural History).

TOWARDS the beginning of April, and too late to receive notice in my paper on Buthidæ for the 'Annals' of that month, Mr. Ransome, to whom we owe the discovery of that interesting new scorpion, *Buthus piceus*, brought to the Natural-History Museum a third specimen of *Buthus* from Madagascar, of which, since it is new and of special interest, I publish the following description:—

Buthus lobidens, sp. n.

Colour.—Trunk above dull, pitchy; legs, palpi, and vesicle paler; chelicerae, abdominal sternites, and coxæ paler than upper surface of trunk, and shining.

Cephalothorax without trace of keels, almost wholly covered with granules; anterior border lightly sinuate and furnished with a series of somewhat larger granules; median eyes large, situated well in the anterior half of the cephalothorax; ocular tubercle deeply cleft, finely granular on each side of the cleft; the posterior median and lateral sulci well marked, but less well marked than in *B. piceus*.

Tergites covered with granules, which are coarser behind than in front; the first six furnished behind with a single small median keel; the seventh furnished behind on each side with two granular keels, which do not unite in front, but attain the posterior margin behind.

Sternites, except the last, which is obsoletely serially granular behind, smooth. *Stigmata* slit-like; the anterior border of the aperture normal; posterior border incomplete, not sharply compressed, as is the anterior border.

Tail very slightly thinner at the apex than at the base; first segment furnished with ten granular keels, intercarinal spaces sparsely granular, shallowly excavated above; posterior granule of superior keels the largest; second segment furnished with eight keels, the median lateral keel being represented by a few granules only in the posterior half of the segment; intercarinal spaces more sparsely granular than those of the first segment; slightly more deeply excavated above than is the first segment; as in the first and the succeeding segments, except the fifth, the posterior granule of the superior keels is the largest; third segment differing from the second as the second does from the first, except that there

is no trace of the median lateral keel and the inferior median keels show a slight tendency to fail posteriorly; fourth segment differing from the third as the third does from the second; the inferior median keels entirely breaking up behind into irregularly arranged granules; upper surface of fifth segment in front with a narrow median depression, which widens behind; bounded laterally by granules; lateral surface beset with smaller and a few larger granules; inferior surface bounded laterally by evenly granular keels, furnished with a median granular keel and beset with larger and smaller granules; vesicle below and at the sides sparsely granular and scantily hairy; aculeus slightly curved.

Palp.—Under surface smooth; humerus furnished above with two granular keels, in front with some larger scattered granules and below in front with a granular keel; brachium with a single short series of granules above and some larger granules in front; hand smooth, without keels, as thick as brachium; fingers slightly curved and simple, *i. e.* without lobe and excavation; hand-back shorter than the immovable dactylus, about two thirds the length of the movable dactylus. Femora of the legs externally thickly granular, coxæ almost smooth.

Legs and palpi more or less hairy.

Pectines short, scarcely two thirds the length of the cephalothorax, furnished with sixteen teeth; the basal tooth very large, lobate, resembling that of *B. piceus*, but a little more circular in form.

Measurements in millimetres.—Total length 66; length of cephalothorax $7\frac{1}{4}$, width 8; distance of eyes from posterior margin $4\frac{1}{2}$; length of tail $39\frac{1}{2}$, of first two segments 10; length of first $4\frac{1}{2}$, width 4; length of fifth $7\frac{1}{2}$, width $3\frac{1}{4}$; length of vesicle $5\frac{1}{2}$, width $3\frac{1}{4}$, height $3\frac{1}{2}$; length of aculeus $3\frac{1}{2}$; length of humerus $6\frac{1}{2}$, of brachium $7\frac{1}{2}$; width of brachium and of hand $2\frac{1}{6}$; length of "hand-back" 5, of movable finger $7\frac{3}{4}$, of immovable finger $6\frac{3}{4}$, of pecten (not including apical tooth) $4\frac{1}{2}$.

A single female specimen from Antongil Bay, Madagascar, collected and presented to the British Museum by Mr. Lewis H. Ransome.

This species is obviously closely allied to *B. piceus* (Pocock, Ann. & Mag. Nat. Hist. (6) iii. p. 349, pl. xv. fig. 8), but may be separated from it by the following characters:—the tail is much more slender and a little longer; the dactyli are longer; there is no large tubercle beneath the aculeus of the caudal vesicle; the stigmata are not ovate.

The specimen here described was taken at a distance of about 30 miles from the spot where *B. piceus* was found, and at first sight, owing to the greater slenderness of its tail and greater length of its dactyli, appeared to be merely the male of that species. But further examination showed that the basal pectinal tooth is considerably the largest of the series, a character which there are good reasons for supposing belongs to the female alone. But even if this be not the case, there exists between the two forms one other difference which, so far as one's experience at present goes, does not fall within the limits of sexual variation. This difference is to be found in the form of the pulmonary stigmata. These apertures in *B. piceus* are ovate; but in *B. lobidens* they are more slit-like and furnish to a certain extent a link between the ovate form of *B. piceus* and the slit-like form found in most other Scorpions. This circumstance justifies the retention of *piceus* in the genus *Buthus*.

LVI.—*The Staphylinidæ of Japan.*

By Dr. D. SHARP.

[Concluded from p. 419.]

Group PIESTINA.

Siagonium nobile, n. sp.

Angustum, subdepressum, piceum; antennarum basi pedibusque rufis; clytris vago rufescentibus, irregulariter punctatis; thorace medio profunde longitudinaliter impresso.

Long. 5 millim.

Antennæ rather stout, moderately long, with scanty hairs. Mandibles porrect, elongate. Head broad, excavate, produced on each side in front so as to form two porrect, acuminate, slightly convergent processes; rather sparingly punctate. Thorax transverse, strongly constricted behind; hind angles rectangular, sparingly punctate, with a very large depression on each side and with an elongate deep depression on the middle. Elytra reddish, black to a greater or less extent behind the scutellum, irregularly, rather sparingly punctate, and longitudinally depressed towards each side. Hind body red at the extremity.

Nikko and Miyanoshita; six specimens.

Siagonium Haroldi.

Siagonium Haroldi, Weise, Deutsche ent. Zeitschr. 1879, p. 148.

One of the most common of the species of Staphylinidæ in Japan. The length of the mandibles and that of the cephalic horns vary extremely; but these adornments are not entirely absent in any of the numerous examples before me.

Siagonium debile, n. sp.

Angustum, subdepressum, nigrum, minus nitidum; antennis, pedibus clytrisque ex parte rufis; capite thoraceque crebrius punctatis, hoc transversim triimpresso; clytris irregulariter punctatis. Long. 3 millim.

Closely allied in structure to *S. nobile*, but differing as follows:—it is only half the size, and the antennæ are a little longer and more slender; the head and thorax are much more densely punctate, the thoracic impressions are much smaller, and the elytra are more uneven and more numerously punctate.

Miyanoshita, Kiga, and Nagasaki; five examples.

Siagonium gracile, n. sp.

Subdepressum, dense punctatum, nigrum, haud nitidum; antennis pedibusque fusco-rufis; thorace aequali; clytris seriatim punctatis. Long. 3–3½ millim.

Antennæ very long and slender. Head broad, abruptly constricted behind, produced in front to form two acuminate processes; densely and evenly punctate. Thorax transverse, constricted behind, densely punctate, unimpressed. Elytra with a series of punctures extending to the extremity. Legs very slender.

Nagasaki, Kashiwagi, Nara, in June; Kurigahara, in August; Miyanoshita, in December; apparently a rare insect.

The nine examples of this species secured by Mr. Lewis show some variation in sculpture, but are no doubt all one species. Though allied to *S. nobile* and *S. debile* in structure, it can be distinguished by a glance at the sculpture and the unimpressed thorax.

PIESTONEUS, nov. gen.

Corpus parallelum, depressum. Coxæ anteriores omnino depressæ. Caput muticum; mandibulæ parum elongatæ, inæquales, superne dentatæ. Tibiæ anteriores graciles, apicem versus externe breviter spinulosæ.

This insect may be placed between *Piestus* and *Siagonium*;

it is distinguished from both by the form of the head and mandibles and is different from *Siagonium* in the apices of the coxæ not being exserted. Head without horns or impressions, the clypeus large but defined only by a very obsolete suture, and presenting a sharp edge in front; labrum not visible. Mandibles strongly curved, rather short, the left with a large tooth on the inner face near the extremity, and on the upper edge with a longer stout process, emarginate at the apex; right mandible rather longer, very greatly curved, without tooth on the inner face, but with a long, incurved, acuminate process on the upper face. Mentum large, nearly semicircular. Prosternum large, front coxæ not at all prominent. Mesosternum large, pentagonal; middle coxæ flat, separated by a very slender process of the mesosternum. Tibiæ slender, the anterior with a few short spinules on the outer edge at the extremity. Tarsi very slender, terminal joint as long as the four preceding together.

This interesting new genus of *Piestina* differs from *Siagonium* by the unexserted front coxæ and the very peculiar form of the mandibles; this latter character in some degree recalls the structure of *Leptochirus*.

Piestoneus Lewisii, n. sp.

Depressus, elongatus, parallelus, niger; antennis, pedibus elytrorumque plaga elongata rufis; capite mutico, mandibulis brevibus, singulis medio superne dente erecto introrsum curvato armatis. Long. 5-9 millim.

Antennæ rather stout, elongate, more or less hairy. Head large, subquadrate, nearly flat, sparingly punctate. Thorax strongly transverse, slightly narrowed behind, sparingly punctate. Elytra much longer than the thorax, with rather irregular series of punctures not reaching to the extremity.

This species is common under bark of trees in the moist forests; it varies much in size, but I do not observe any sexual distinctions, though it is probable that the smaller specimens, in which the antennæ are shorter and less hairy, are of the female sex.

Thoracophorus certatus, n. sp.

Subcylindricus, rufus, opacus, longitudinaliter sculpturatus; thorace elongato, angulis anterioribus lateraliter subprominulis. Long. 3 millim.

Antennæ short, eighth to tenth joints transverse. Head with the hind angles well marked, eyes not visible from

above; with two oval elevations on the middle behind. Thorax about as long as broad, a little narrowed towards the front at the sides till near the anterior angles, which are thus slightly prominent; near each side there is a fine raised line meeting the lateral margin some distance in front of the hind angle, and nearer the middle there is a more elongate raised line, furcate in front, the surface between these lines obscurely rugose. Elytra longer than the thorax, each with several fine, elongate, raised lines. Hind body with the basal segments rough, covered with elongate raised granules; apical segments nearly smooth.

Nishimura, Oyayama, Kashiwagi, Nara; four specimens from the galleries of wood-boring Coleoptera.

Allied to *T. (Glyptoma) costalis*, Fr., but longer and more slender and with well-marked distinctions in the details of the sculpture.

Lispinus aper, n. sp.

Brevis, dense punctatus, fere opacus, niger; elytris piceis; antennis pedibusque rufis.

Long. $2\frac{1}{2}$ millim.

Antennæ stout, seventh to tenth joints transverse. Head short, much narrower than the thorax, finely punctate, eyes very small. Thorax transverse, rather narrower than the elytra, a little narrowed behind, with a deep fovea on each side, rather closely punctured. Elytra longer than the thorax, bearing a dense, fine, subrugose sculpture. Hind body rather short, with obsolete oblique striæ.

Miyanoshita, Nagasaki, Oyayama, Kashiwagi; scarce.

There is no species known to me at all like this one.

Eleusis coarctata, n. sp.

Depressa, nitida, nigra; elytris piceis; antennis pedibusque rufosordidis; thorace basin versus fortiter angustato.

Long. 4-5 millim.

Antennæ rather long, red, seventh to tenth joints each about as long as broad. Mandibles elongate, red. Head large, elongate, nearly straight at the sides, with a deep elongate depression on each side, the surface finely and sparingly punctate and minutely strigose. Thorax not so long as broad, very greatly narrowed behind, so that at the base it is not more than half as broad as the elytra, minutely sinuate at each side in front of the lateral seta, finely and sparingly punctate and minutely strigose and very finely

canaliculate. Elytra longer than the thorax, each with a large puncture on the middle and with a few very fine punctures. Hind body finely but quite definitely margined, the margins testaceous.

Found under the bark of beech at Yuyama, and also met with at Sapporo and Nikko.

In this species the sinuation of the thorax in front of the lateral seta is greater than usual.

Eleusis subtilis, n. sp.

Depressa, nitida, nigra; clytris flavis, margine posteriore nigro; antennis pedibusque rufis; thorace basin versus fortiter angustato.

Long. $3\frac{1}{2}$ millim.

Antennæ slender, clear red, penultimate joints each longer than broad. Head elongate, narrow, with deep lateral groove. Thorax nearly as long as broad. Elytra pale yellow, with the hind margin black, each with an obsolete puncture on the disk.

Yuyama and Oyayama, in Kiushiu.

Besides being smaller and narrower than *E. coarctata* and of a different colour, this species is more obsoletely sculptured.

Trygæus princeps.

Trygæus princeps, Sharp, Trans. Ent. Soc. Lond. 1874, p. 420.

This species was procured again by Mr. Lewis at Oyayama, Hakone, but it remains rare. It was found under dead leaves and rushes in wet places.

Nodynus leucofasciatus.

Nodynus leucofasciatus, Lewis, Ann. & Mag. Nat. Hist. (5) iv. p. 460.

The genus *Nodynus* was described a few years since and placed among the Silphidæ. Its proper position is, however, in the *Trigonuri* group of the family Staphylinidæ. On opening the elytra it is found that all the dorsal segments of the hind body are corneous, and as in the other parts of its external structure it agrees closely with *Trygæus* and *Trigonurus*, I do not think there can be any doubt as to its position. It is not at all extraordinary that it should have been previously referred to the Silphidæ, as it must be admitted that at first sight its appearance would not suggest that it should be placed in the Staphylinidæ, and as the Silphidæ are allied to this group of Staphylinidæ, it was not very far wrong to place *Nodynus* among the Silphidæ. In Schönfeldt's Catalogue of Japanese

Coleoptera the genus is placed in its true position, next to *Trygæus*.

Occurs with *Ips*, *Peltastica*, and other beetles at the rancid sap of wounded trees. Not rare and widely distributed in the forests.

Group LEPTOCHIRINA.

Priochirus japonicus, n. sp.

Subcylindricus, nigerrimus, nitidus; tibiis apicem versus tarsisque rufescentibus; mandibulis brevibus, dente superiore gracili, erecto, valde curvato; vertice in medio conis duobus suberectis approximatis munito.

Long. $13\frac{1}{2}$ millim.

This species is not closely allied to any other, but may be placed near the Ceylonese *P. mandibularis*, Kr. The very short mandibles are remarkable on account of the very divergent teeth, the superior or upright tooth being much curved. The head has the vertex very deeply canaliculate in the middle and in front projects in the form of two elongate conical tubercles, directed more forwards than upwards; on each side of these prominences the surface is depressed and has some coarse irregular sculpture. The thorax is short, strongly transverse, rather convex, deeply canaliculate, and with numerous punctures at the base. The elytra are elongate, much longer than the thorax, longitudinally depressed near the outside towards the extremity.

Occurs plentifully in the touchwood of old beech-trees in all the elevated forests, especially at Hakone, Oyayama, and in the island of Sado.

Group PROTEININA.

Megarthus hemipterus.

Megarthus hemipterus, Er. Gen. et Spec. Staph. p. 906.

Two specimens; found at Bibi or Nikko.

Megarthus corticalis, n. sp.

Latus, ferrugineus; elytris pallidioribus, late nigro-scriptis, fortiter punctatis.

Long. $2\frac{1}{3}$ millim.

Antennæ very slender, the two basal joints stout, the apical joints infusate. Thorax strongly transverse, subobsoletely rugose-punctate, with a very deep channel on the middle, sides

scarcely sinuate till near the hind angle, there obliquely narrowed, but scarcely excised. Elytra extremely coarsely punctured; on the hinder margin of each is a black mark, extending forwards and furcate, one branch nearly attaining the lateral margin and the other nearly touching the suture. Male with the middle tibiæ strongly curved and the inner face of the hind tibia armed above the middle with a strong tooth.

Oyayama, 12th March, 1881.

Megarthrurus scriptus, n. sp.

Flavo-ferrugineus; elytris fortiter punctatis, ad apicem nigromaculatis.

Long. vix 2 millim.

Apparently closely allied to *M. corticalis*, but smaller, and with the basal two joints of the antennæ more slender and the black mark differently disposed on the elytra, the extension of it forwards towards the outer margin being absent.

Only two specimens have been procured; they are no doubt males, the inner tibiæ being slender and slightly excised below the base and a little angulate; the hind tibiæ are slender and simple.

Yuyama and Chiuzenji; two specimens.

Subfam. *OMALIINÆ*.

Anthophagus aquatilis, n. sp.

Latus, subdepressus, niger, nitidus, palpis tarsisque rufescentibus; antennis articulo basali dilatato; prothorace transverso, subtiliter punctato.

Long. 6-7 millim.

Antennæ slender, very long, basal joint elongate, much thicker than the others; terminal joint of maxillary palpus very small. Head large, as broad as the thorax, deeply depressed in front, and with a large, broad, deep impression on the middle of the vertex behind; punctuation obsolete. Thorax very much narrower than the elytra, strongly transverse, much narrowed behind, hind angles rectangular, sharply defined, the surface rather finely and not deeply punctate, with an impression on the middle in front. Elytra broad, more than twice as long as the thorax, rather coarsely, moderately closely punctured, shining. Legs slender; tarsal claws long and slender, without lobes.

Captured plentifully under stones in the water at the edge of the lake at Hakone in May 1880.

Anthophagus sinuatus, n. sp.

Nigerrimus, nitidus: antennis ad apicem tarsisque rufescentibus; thorace transversim cordato, fortiter punctato, ante basin in medio impresso.

Long. 5-6 millim.

Antennæ elongate, the apex and also the third joint red. Head only about half as broad as the thorax, impressed on the middle behind. Thorax much narrower than the elytra, strongly transverse, greatly rounded at the sides and sinuate behind, the hind angles rectangular, the surface coarsely punctate, and with a very distinct impression or large fovea near the base on the middle. Elytra twice as long as the thorax, much narrowed at the shoulders, shining black, rather coarsely and not closely punctured.

Sapporo; six examples.

This species and the following one are allied to the European *A. plagiatus*, and could be placed quite naturally in the genus or subgenus *Geodromicus*, which is characterized by the absence of membranous appendages from the claws.

Anthophagus caliginosus, n. sp.

Niger, minus latus, evidenter pubescens, fortiter punctatus: prothorace cordato, medio subcanaliculato, ad basin depresso.

Long. 5 millim.

Head very much narrower than the thorax, the vertex broadly and deeply impressed. Thorax large, scarcely narrower than the elytra, greatly narrowed behind, very coarsely and deeply punctate, the base depressed, an indistinct depression along the middle and an obscure fovea at the base. Elytra rather narrow, parallel, coarsely punctate. Legs black, tarsi pitchy, front femora thick.

Hiogo; one specimen.

Anthophagus lestevoïdes, n. sp.

Piceus; antennis tibiis tarsisque fusco-testaceis, femoribus flavis; elytris versus humeros plaga vaga rufescente.

Long. $4\frac{3}{4}$ millim.

Antennæ elongate, moderately stout, the basal joints more clear red than the others. Head small, narrower than the thorax, surface uneven, coarsely punctate. Thorax small, much narrower than the elytra, transverse, much narrowed behind and sinuate at the sides; hind angles almost rectangular, coarsely and rather closely punctate, with a vague

depression in front of the base in the middle. Elytra nearly twice as long as the thorax, narrowed at the shoulders, coarsely sparingly punctate, shining, rather variable in colour, with a dark triangular patch about the scutellum; outside this reddish, and usually again darker towards the sides and apex, but the limitation of these colours is very variable. The side margins of the hind body are sometimes yellow.

Hakodate.

Anthophagus subtilis, n. sp.

Fusco-piceus; capite thoraceque ferrugineis; antennis fuscis, basi, palpis, pedibus elytrisque rufis, his apicem versus obscuratis; subtiliter punctatus.

Long. 5 millim.

Antennæ very slender. Palpi clear red, penultimate joint a good deal swollen, terminal joint minute. Head rather elongate and narrow, with two slender convergent impressions on the vertex. Thorax much narrower than the elytra, transverse, flat, the sides greatly rounded in front, gently sinuate behind, hind angles rectangular, sharply marked, not depressed, surface quite obsoletely punctate, without channel or fovea. Elytra rather short, scarcely twice as long as the thorax, finely punctate and pubescent, not shining, red, darker about the hind margin.

Summit of Iwakisan; two mutilated examples.

This is a very peculiar species; there are no lobes on the claws, but it does not otherwise resemble the species of *Geodromicus*.

Lesteva crassipes, n. sp.

Nigra; antennis fusco-rufis, pedibus piceis, femoribus basin versus rufis, palpis tarsisque testaceis; elytris fortiter punctatis.

Long. 6 millim.

Antennæ very long, extremely slender, infusate red, the terminal joints dilute red, not infusate. Head narrow, deeply biimpressed. Thorax only about half as broad as the elytra, not quite so long as broad, greatly rounded at the front angles, thence greatly narrowed behind, the narrowing being in an oblique line, not sinuate; surface unimpressed, obsoletely and not densely punctured. Elytra much broader from the shoulders to the apex, moderately coarsely and closely punctate, shining, with a distinct erect pubescence. Front and middle femora stout.

Oyayama and Yokohama, in May; three specimens.

A distinct species, of similar appearance to those of Europe.

Lesteva plagiata, n. sp.

Fusco-nigra, nitida, pube erecta vestita ; antennis, palpis pedibusque testaceis ; elytris singulis basin versus plus minusve vage rufoplagiatis.

Long. 4 millim.

Antennæ moderately long, slightly thicker towards the extremity. Head a little narrower than the thorax. Thorax small, only about half as broad as the elytra, broadly but feebly biimpressed on the middle, distinctly but rather sparingly punctate, shining. Elytra sparingly, rather coarsely punctate, shining. Legs clear yellow.

Yokohama, Oyayama, and Miyanoshita.

This is extremely different in punctuation from *L. fenestrata*, which is similarly coloured ; it has a greater resemblance in appearance to *Anthophagus lesteroides*, but the structure of the palpi in the two insects is very different.

Amphichroum debile, n. sp.

Angustum, subdepressum, piccum ; capite abdomineque nigris ; antennis, pedibus elytrisque flavis ; prothorace transverso, sublævigato.

Long. 4 millim.

Antennæ setose, penultimate joint quite as long as broad. Head exserted, slender, narrowed but not at all constricted behind the eyes, which are prominent and placed much in front of the thoracic margin ; finely punctate, very deeply biimpressed between the eyes. Thorax transverse, piccous black, with the margins more dilute, the sides gently rounded, the hind angles also rounded, the surface shining, impunctate.

Elytra long, narrow, twice as long as the thorax, rather closely and finely punctate, with a few fine exserted setæ arranged serially. Legs slender, middle tibiæ strongly spined, hind tarsi very slender, terminal joint nearly as long as the four preceding together ; genæ not margined.

Yokohama, 4th Feb. 1881 ; three specimens.

This is scarcely congeneric with the European *A. canaliculatum*, but may probably be more nearly allied to some of the Californian forms at present referred to this genus. *A. floribundum*, Lec., is nearer to it than any other species I possess.

Olophrum vicinum, n. sp.

Subdepressum, piccum, capite pectoreque nigricantibus ; elytrorum marginibus, antennis pedibusque testaceis ; fortiter punctatus ;

prothorace transverso, angulis posterioribus obtusis haud rotundatis.

Long. $4\frac{1}{2}$ millim.

Antennæ rather long and slender, slightly thicker externally; penultimate joint longer than broad; palpi yellow. Head sparingly and distinctly but not coarsely punctured. Thorax about twice as broad as long, a good deal narrower than the elytra, nearly truncate in front, gently rounded at the sides in front, and narrowed behind, somewhat coarsely and sparingly punctured. Elytra about twice as long as the thorax, coarsely punctate.

Iwakisan; four specimens.

Closely allied to *O. simplex*, but larger, darker in colour, more coarsely punctured, and with all the angles of the thorax less rounded.

Trigonodemus lebioides.

Arimimelus lebioides, Kr. Deutsche ent. Zeitschr. 1887, p. 105.

Oyayama and Nikko, in June. Occurs in large fungi on trees.

I am indebted to Dr. Horn for pointing out to me that this insect is probably congeneric with the very rare North-American *T. striatus*, Lec. Kraatz, when he described *Arimimelus*, placed it in the family Silphidæ, thinking it allied to *Pteroloma*. The Japanese insect is very rare, so that I have not at my disposal a specimen for dissection; but I see no reason for doubting that the position near *Lathrimæum* assigned to *Trigonodemus* by the North-American entomologists is correct. At any rate the Japanese insect is but remotely related to *Pteroloma*. Whether the Japanese and North-American insects are strictly congeneric there is some doubt, as the species from the latter region is unknown to me and Leconte's characters for the genus are very brief; the only discrepancy I notice between those characters and the Japanese insect is that in the latter the middle tibiæ are almost entirely unarmed.

Eudectus rufulus.

Eudectus Giraudi, var. *rufulus*, Weise, Deutsche ent. Zeitschr. 1877, p. 96; Sharp, Ent. Month. Mag. xxiii. p. 209.

Nagasaki, 25th March, 1881; a single example.

Omalium curtellum, n. sp.

Breve, convexum, nitidum, testaceum, glabrum, fortiter punctatum; antennis crassiusculis.

Long. 3 millim.

Antennæ stout, thicker towards the extremity, fourth joint minute, fifth to tenth each transverse, the last of them strongly so. Head only about half as broad as the thorax, sparingly punctate. Thorax strongly transverse, being twice as broad as long, very convex transversely, rounded at the sides and narrowed in front, hind angles completely rounded, surface coarsely, rather sparingly punctate, unimpressed. Elytra convex, twice as long as the thorax, somewhat coarsely, moderately closely punctate. Hind body very broad and short, much curved at the sides, lateral margins broad. Legs slender, middle tibiæ very feebly spinose externally; terminal joint of hind tarsus much shorter than the four preceding together.

Miyanoshita; in the flowers of *Edgeworthia chrysantha*, 19th March, 1880.

This insect will not enter into any of the subgenera of *Omalium*, and will perhaps form a distinct subgenus or genus connecting *Omalium* and *Lathrimæum*.

Omalium niponense, n. sp.

Rufum, capite nigricante, subnitidum, fortiter rugoso-punctatum; thorace inæquali.

Long. $3\frac{1}{2}$ millim.

Antennæ stout, entirely red, very little thicker externally. Head black, shining, coarsely punctate, very deeply biimpressed. Thorax strongly transverse, much narrower than the elytra, nearly straight at the sides, surface coarsely punctate and very uneven, being impressed on each side and having two large, very deep depressions on the middle. Elytra more than twice as long as the thorax, light red, very densely and deeply, rugosely punctured.

Kashiwagi, 23rd June, 1881; one specimen.

A very distinct species allied to *O. septentrionis*, Th., and *O. nigriceps*, Kies.

Omalium diffine, n. sp.

Angustulum, subdepressum, nitidum, nigrum; clytris fuscis, antennarum basi pedibusque testaceis; fortiter haud dense punctatum; prothorace minus fortiter transverso, dorso late obsolete biimpresso.

Long. 2 millim.

Antennæ much stouter externally, fourth and fifth joints small, sixth slightly transverse, tenth strongly so. Head black, shining, sparingly punctate. Thorax a little narrower than the elytra, nearly straight at the sides, black, shining,

sparingly punctate, and only feebly biimpressed on the middle. Elytra nearly twice as long as the thorax, coarsely, moderately closely punctate.

Hitoyoshi, 8th May, 1881; one specimen.

An obscure little *Omalium* allied to *O. japonicum*, but much smaller, differently coloured, and more sparingly punctate.

Omalium tenue.

Homalium tenue, Weise, Deutsche ent. Zeitschr. 1877, p. 95.

This apparently has not been met with by Mr. Lewis; it was found at Hagi by Hiller.

Omalium daimio, n. sp.

Sat elongatum, subparallelum, rufescens; capite elytrorumque apice nigricantibus; elytris seriatim sat fortiter punctatis.

Long. 4 millim.

Antennæ red, fifth joint considerably broader than the fourth, fifth to tenth similar to one another in width, each slightly transverse. Head broad and short, in front biimpressed; on the vertex there is a curved elevation between the ocelli. Thorax nearly as broad as the elytra, narrowed behind, moderately closely and finely punctate, somewhat shining, not impressed, but bipunctate close to the front margin. Elytra yellowish red, shining, the suture narrowly, the hind margin broadly, infusate, seriate-punctate in a very distinct manner.

Yuyama, 10th May, 1881; one specimen.

A very distinct species of the *Xylodromus* group.

Omalium denticolle, n. sp.

Dense punctatum, dense subtiliter pubescens, parum nitidum, fusco-piceum; antennarum basi, prothoracis lateribus, elytrorum lineis duabus obliquis pedibusque rufis; prothorace lateribus obtuse bidenticulatis.

Long. vix 3 millim.

Antennæ moderately long, pubescent, five basal joints red, the following six darker and also stouter. Head blackish, densely, rather coarsely punctured. Thorax strongly transverse, quite twice as broad as long, densely punctate, the disk very obsoletely biimpressed, each side margin bearing two prominences on the middle, the anterior very small, the next larger. Elytra about twice as long as the thorax, densely, rather coarsely punctate, each with a red oblique mark, proceeding from the shoulder towards the suture. Male with the lower half of the inner face of the hind tibia rather

deeply excised and the hind margin of the penultimate and antepenultimate ventral plates each armed on each side of the middle with a very prominent tubercle.

Miyanoshita and Nagasaki in winter ; several examples.

I am not acquainted with any species allied to this.

Anthobium minutum ?

Silpha minuta, Fabr. Ent. Syst. i. pt. 2, p. 254.

Nikko ; one specimen.

The example is a male, and until the other sex has been found it is not certain that this is really the same as our common European species.

Anthobium pollens, n. sp.

Nigrum ; antennarum basi pedibusque testaceis ; capite thoraceque subopacis, subtiliter punctatis ; elytris nitidis, elongatis, fortius punctatis.

Long. 3 millim.

Antennæ with the basal four joints yellow, the others fuscous, fifth joint much broader than the fourth, fifth to tenth joints differing very little from one another, each about as long as broad. Thorax rather large, nearly as broad as the elytra, nearly twice as broad as long ; surface very dull, smooth, but finely and regularly punctured. Elytra twice as long as the thorax, nearly truncate behind, closely and rather coarsely punctured, shining.

Kiga and Suyana, May 1880 ; two specimens.

This insect is larger than *A. minutum* and has a larger thorax and much larger fifth joint to the antennæ. The two individuals are probably of the female sex.

Anthobium parallelum, n. sp.

Angustum, subparallelum, brunneum (maris abdomine nigro) ; antennis, pedibus elytrisque testaceis illarum apice nigro ; thorace elytrisque omnium subtilissime pubescentibus.

Long. $2\frac{1}{2}$ millim.

Antennæ slender, scarcely thicker from the base till the seventh joint, which is slightly broader than the sixth, penultimate joints feebly transverse. Thorax about as broad as the elytra, strongly transverse, about twice as broad as long, very dull, very minutely punctate. Elytra twice as long as the thorax, densely and rather finely punctate, apices similar in the sexes, truncate.

Miyanoshita ; a good series.

This little insect is narrower and more parallel than most of its congeners.

LVII.—On *Butterflies' Enemies*. By SYDNEY B. J.
SKERTCHLY, F.G.S., M.A.I.

I. *Introduction.*

THE following notes are the result of observations in the forests of British North Borneo. They were written in the jungle with the butterflies about me, and, I think, throw a little new light on the questions of protective resemblance and mimicry, especially in relation to hereditary memory.

Mr. W. B. Pryer, in his notes on the *Rhopalocera* of British North Borneo, casts a doubt on certain points connected with the theory of mimicry, stating that during twenty years' collecting in the far east he never saw a butterfly taken by a bird*. Discussing this question with him in England and Borneo I was led to study the matter more particularly, and as my work takes me for months at a time into the virgin forest, my opportunities have been unusually great.

My references must be few, as my library is necessarily very small; but this is hardly a drawback, since the observations are original, and there has already been quite enough theorizing from published data. The literature of the subject is, however, quite familiar to me.

II. *The Evidence as it exists.*

That mimicry does exist probably no one has ever doubted since Bates first called attention to the phenomena. The explanation, too, proffered at the time, that edible species copied nauseous morsels, was so simple, so full, so entirely explanatory that, like Darwin's theory of coral-reefs, it seemed unassailable. Indeed, so strong was this feeling, that few naturalists ever seem to have looked for facts to support it.

Yet how meagre the evidence is! Surely if birds are in the habit of eating butterflies as a staple article of food, the fact would be patent to every ornithologist and entomologist, to everyone who delights in the beauties of nature. Such is not the case, and even Distant, in his '*Rhopalocera Malayana*'†, can only cite a few isolated cases. That some birds frequently, and others occasionally, devour butterflies is certain. But these are rare exceptions, and not the rule.

Mr. Pryer's remark has been paralleled by Mr. Scudder,

* Ann. & Mag. Nat. Hist. Jan. 1887, p. 44.

† P. 169.

and after thirty years' observation of insects and birds in Europe, Asia, Africa, and America I can confidently assert that I have never yet seen a bird take a butterfly. Once I saw a black-headed bunting in Wicken Fen snap up a *Callimorpha dominula* (a moth) and immediately drop it, and on mentioning the case to Wallace he was struck with its rarity and asked me to record it. The other day I saw a small Trogon dart at a *Terias* unsuccessfully; but these are the only approaches to the capture of butterflies that have ever come under my notice.

I venture to think there is an explanation of this curious apparent anomaly.

III. *Protective Resemblance and Mimicry.*

Wallace first saw that there were two distinct though allied classes of phenomena often even now confounded together. These he termed protective resemblance and mimicry. Under the former head he classes such cases as leaf-insects, leaf-butterflies, sand-coloured desert-insects and birds, the tiger's stripes, the leopard's spots, and the thousand other cases in which concealment is effected by assimilating the colouring to the environment. Under the latter he groups all the cases in which one insect mimics another.

This distinction, though often lost sight of, has perhaps a deeper meaning than was foreseen, as will presently be shown.

I wish for my argument to emphasize this great distinction and to remind the reader that protective resemblance copies *stationary* objects, mimicry simulates *moving* ones.

IV. *New Reasons in favour of the Theory of Protection.*

Apart from the indisputable fact that butterflies do mimic other insects, leaves, the bark of trees, the ground, and what not, there are one or two facts that I may add to the great stock of speculative evolution.

One is the great shyness of butterflies. The least movement startles them: some fly right away, others (especially forest species) rapidly conceal themselves. Is it not reasonable to suppose they show fear *because they are afraid of something*? The shyness of other animals is due to fear, and why not that of butterflies? It is a fear, too, of something that moves, for they will come all round and even settle on you if you are quite still, as I have experienced with several species of "Blues," with *Papilio sarpedon* and its allies, and even with the swift-flying *Curetis*. It is not a fear of being

trodden upon or knocked, for high-flying species are just as shy.

Again, many butterflies can "dodge" a moving danger. I do not mean simply get out of the way—anything can do that—but really dodge, with a sudden upward, downward, or sideway motion. I do not know any English species clever in this direction; but here in Borneo many species of *Papilio*, *Catopsilia*, *Appias*, *Udriana*, &c. will dodge a net-stroke with exasperating facility.

Similar dodging-powers pertain to many Erycinidæ while at rest. It is almost impossible to catch an *Abisara*, for instance, while at rest: strike downwards, and they drop; strike upwards, and they bolt; sideways, and away they go.

It has been urged that butterflies are very near-sighted, for they have been seen bumping up a wall, as if they could not see the top and did not know how high to fly to get over. But no one can watch great *Hestias* and *Ornithopteras* sailing among the trees unscathed, or fragile many-tailed *Bilauulus* flitting unharmed through the undergrowth, without being sure they can at least avoid obstacles.

Another argument can be based upon protective resemblance. It is far more common than mimicry, and it would be hardly too much to say that it is nearly universal among butterflies, and would be more readily noticed if we were more in the habit of watching insects than catching them. Even the most vividly coloured insects are often perfectly protected when at rest. I have watched, for instance, the silver-splashed *Argynnis bathenia* near Florence pitch with folded wings among the stones, and not a trace of glittering betrayed it.

This protection is nearly always confined to the under surface, and generally to the hind wing and tip of the fore wing—a fact the significance of which will shortly appear. A butterfly at rest with folded wings only exposes the tip of the fore wing, and if the under surface is too glaringly coloured, as in our English Orange-tip (*A. cardamines*), its brilliancy is subdued by a dark tip. It is singular how obscure metallic colours appear when a butterfly is at rest. Thus the Bornean *Abisaras* have vivid metallic blue streaks on the under surface of the hind wing; yet they are very difficult to see when pitched.

Another well-known means of protection exists in those insects whose bodies are replete with a strong-smelling, nauseous, generally oily, yellow secretion. This is generally, if not always, accompanied by great vitality. The wings are generally long and pointed and the bodies of a peculiar shape.

Every English entomologist has noticed similar traits among moths, as in the Burnets (*Zygena*), the Cinnabar (*Euchelia jacobæa*), the Currant (*Abraeus grossulariata*). They are all nauseous and all very hard to kill. Among butterflies this is well marked in the genus *Danaüs*, and their strong vitality I have tested in Southern Europe, Northern Africa, the Straits Settlements, Borneo, the Celebes, and the Moluccas. I believe that a nauseous secretion and strong vitality always go together.

Strong vitality, again, is often correlated with long wings, but not with all long-winged butterflies. It occurs in *Ornithoptera*, *Hestia*, *Idea*, *Ideopsis*, *Euphara*, and *Danaüs*, but not in *Neptis* and *Athyma*. *Danaüs* possesses both round and long-winged species.

These may be "explained" as correlation, but to me that is only an evolutionary shibboleth for "it *is*, but we don't know why."

None of these specially protected forms avoid publicity. They flap along, quickly or slowly, but always with a jaunty "look at me" sort of air, quite different from such round-winged creatures as *Papilio*, *Charaxes*, *Thaumantes*, or *Melanitis*. Surely we see here what might be termed ostentatious protection!

Contrast these cases with low-flying butterflies like our English Browns, the Bornean *Ypthima* and *Mycalesis*. They flit along, suddenly pitch, close their wings, and are invisible. Often they creep down among grass-roots, and I have seen *Ypthima* hide under stones. So with the "Blues" and "Purples" out here. They flash in the sunshine or forest shade like rapidly revolving blue lamps. They *must* be seen, or the lovers would never meet; but it would take an active bird, as it does a dexterous naturalist, to catch one. When they pitch, down goes the upper wing, and only the knife-edged lower wing and tip of upper wing are exposed, and a sharp eye alone can see them. All these forms are easily killed, and they are undoubtedly protected.

Collating these data, the following inferences seem legitimate:—

1. The almost universal shyness of butterflies indicates fear.
2. The way that shyness is expressed shows fear of moving objects.
3. The theory of mimicry presupposes (*a*) that danger is universal, (*b*) that some butterflies escape danger by

secreting a nauseous fluid, (c) that other butterflies noticed this immunity, (d) that they copied it.

4. It would be of comparatively little use to an insect to be unpalatable if the insect were killed in being tasted. Hence these forms have very strong vitality.
5. Protective resemblance being almost universal shows a strong sense of danger.
6. Being generally confined to the under surface it ensures protection during the period of rest. In this it differs radically from mimicry.

V. *Mimicry's* Raison d'être.

Mimicry we have suggested is a protection against foes which attack butterflies upon the wing. I take it that the amount of danger may be measured by the pains taken to avoid it. On this principle butterflies are in much greater peril when resting than when on the wing; otherwise mimicry would be as common as protective resemblance.

The only foes worthy of such efforts as are displayed in mimicry are birds. Lizards, snakes, and monkeys may occasionally snatch a butterfly, but birds must always have been the chief foes. Yet we have seen that butterfly-eating birds form a very small minority both in species and individuals in the avifauna of the world.

Insectivorous birds vary much in their habits. At one end of the scale the woodpeckers and creepers fish insects out of holes, at the other end swallows and swifts catch all their food upon the wing. Between these tits hunt over branches, warblers flit among the leaves, flycatchers make short darts at passing flies. Moreover, birds are capable of profound modification of structure and habit, as in the case of swifts transformed into humming-birds.

Now I suggest that, as shyness and mimicry are proofs of a sense of danger from moving foes, and as the effort so displayed is disproportionate to the danger *as existing at present*, it may be that formerly butterfly-catching birds were more plentiful than now; in other words, that shyness and mimicry are habits acquired long since which have survived the necessity that gave them birth.

This supposes a change in the habits of many insectivorous birds. Such a change may have been assisted by the obvious fact that a butterfly, looked upon as food, is so much more chaff than grain—his edible body so small, his unnutritious wings so large. He must be troublesome to catch, very un-

satisfactory to a hungry healthy bird when caught. Dragon-flies enjoy similar safety for like reasons.

VI. *The Raison d'être of Protective Resemblance.*

Applying the law that the amount of apprehended danger is measurable by the efforts taken to avoid it to protective resemblance, and remembering the almost universality of protective resemblance, the conclusion is forced upon us that butterflies when at rest are or were in far greater danger than when on the wing. At first sight this seems axiomatic, since it is clear that more foes are capable of capturing a sleeping than a flying prey. But when we see how comparatively rare mimicry is, and how almost universal protective resemblance is, it is hard to escape the conclusion that if, as suggested, the one refers to dangers almost past, the other has reference to dangers coeval with butterfly life and imminent up to the present time. We must remember that a collection of *proved* mimetic forms (many are spurious) can be got into a cabinet—a collection of protected forms requires a museum. I wish instead of reading this argument, for it reads feeble, entomologists could be with me here day after day, month after month, with all the wealth of tropic forms about me, to realize the great *fact* that one looks upon a new case of mimicry as a prize, but that a non-protected-resemblance species is a greater prize still.

Butterflies rest by day partly, by night always. All butterflies rest a little by day, while they suck flowers or leaves, for in Borneo more butterflies rest on leaves than flowers and many leaves are aromatic. For instance, most species of *Nacaduba*, *Tajura*, *Poritia* (Blues), and even *Apias* (Whites) live upon leaves and are rarely seen at flowers. Other butterflies are crepuscular, like *Melanitis* and *Thaumantis*, and these rest nearly all day. Hence most of a butterfly's life is spent resting. Even if foes were as expert (as swallows are with flies) in capturing flying as resting insects, most would be killed while at rest. But while only birds can catch flying butterflies, birds, lizards, ants, and beetles can capture them when at rest.

The necessity for good protection while at rest is therefore great, and hence we see protective resemblance so common; hence we see it almost exclusively applied to the under surface—the exposed surface in a state of repose.

The struggle for existence in Borneo is glaringly apparent. The country is warm, moist, with perpetual summer. Insect- and plant-life thrive to a degree not realizable at home and

competition is very severe. All sorts of insects—beetles, bees, flies, and what not—are being perpetually thinned out by insectivorous mammals, birds, lizards, frogs, wasps, and ants. One often wonders how any escape, and few would unless all sorts of protective schemes had been adopted to cope with the destroying hosts. Hence the leaf- and stick-insects, hence the universal protection of tropical larvæ. The struggle for existence is no theoretical explanation in Borneo, but a patent cruel fact. Turn the ants loose over England and the British insect-fauna would be destroyed in a year.

Yet I never saw ants touch a living butterfly. Dead ones, as every collector knows but too well, fall a prey to the pests in an incredibly short time, and there is no doubt living ones are equally palatable *if they could be obtained*. Protective resemblance I believe alone saves butterflies from extermination by ants—they do not recognize their food when it is at rest. Butterflies when reposing hide very carefully; but one cannot believe they can select places inaccessible to ants. Yet it is certain but few fall a prey to ants, or the wings of the victims would be much more plentifully found. Some of the small Blues occasionally hide under stones, and I have now and then found the wings, which seemed to be the remains of ants' depredations. I confess that though this seems to be the fact, its explanation is difficult. The resemblance of a butterfly to a leaf or stone may well be a protection in the daytime, but in the long dark equatorial nights it would not seem to matter much whether the butterfly were so protected or not, especially as we know that ants have a keen sense of smell. One would have thought the night-marauders would have hunted by scent and not by sight; but they do not—at least they do not succeed with butterflies to any great extent. I have watched ants both day and night, and our Borneo species seem always to prefer dead or dying prey—centipedes, millipedes, scorpions, defunct or moribund, may be seen carried off in triumph, but a butterfly or moth, or any really alive and kicking creature, never.

We have no foraging *Ecitons* here, nor anything like them; but Belt, though he enumerates all kinds of other creatures turned out and slain by the ant armies in America, does not mention butterflies, but he *does* record the case of a leaf-locust that stood stock still amidst the foragers, who utterly failed to recognize him as meat. This is a good case in point, for *Ecitons* have poorly developed eyes and might be expected to hunt by scent, whereas we have a clear case of them failing to recognize a protected insect.

My attention was directed by my son, E. F. Skertchly, to

some peculiar mutilations of the wings of butterflies, which have led us to think that perhaps lizards and small insectivorous mammals are to be added to the list of foes, and that they are more successful than ants. It is not unusual to capture butterflies which have both hind wings mutilated in the same manner, as if a piece had been bitten out. We first noticed it in the crepuscular species *Melanitis leda*; and I find that Distant figures a specimen of *Panchala apidanus* said by its captor to have been bitten by a bird, but no details are given*. Since then we have found this not uncommon, and a list is appended of the species in which it has been noticed. Of course these specimens represent only a few of those which escape, but they are sufficiently numerous to show that the phenomenon is not accidental.

Melanitis leda and *Amathusia philippus* are crepuscular and lie hid nearly all day and all night; hence they may be bitten by birds in the daytime, but I do not think it likely. The Satyrinæ, like *Mycalesis* and *Ypthima*, fly low, never rising more than 4 feet above ground, and they hide by night in the grass as well as by day in dull and rainy weather. *Papilio sarpedon* is a very swift flier, with a habit of settling in compact flocks on damp sand, and it is highly unlikely that they are ever molested by day. *Hestia* seldom settles by day, is one of the earliest on the wing and the latest to retire. It certainly does not fear birds, for it never flies quickly nor attempts concealment. Here, then, we find examples of butterflies of the most diverse habits all subject to similar mutilation.

The conclusion seems inevitable: butterflies are bitten chiefly by night, when they are most defenceless. Both hind wings are bitten symmetrically, so that when the wings are folded as in repose the mutilations correspond. Protective resemblance seems to be the only mode of ensuring safety during sleep.

The only creatures that appear likely to hunt sleeping butterflies are lizards and perhaps some of the small insectivorous mammals. Lizards are enthusiastic moth-hunters, and my son has seen a little house-lizard capture one.

It will be noticed that no examples of the Erycinidæ or Lycanidæ are recorded. I have not yet seen one of the latter mutilated that I could be sure of. So many are delicately tailed and get so damaged by the net that it is difficult to make certain on this point. I think they are mutilated. I know as yet no case of a mutilated species of the Hesperiidæ.

It will be noticed that species protected by nauseous secretions do not escape. *Hestia* and *Euploea* are cases in point. A mutilated *Danaïs* I have not seen.

* Rhop. Malayana, p. 273

In point of numbers the Satyrs suffer most, as might have been expected. It is quite common to find *Melanitis* mutilated.

We hope to gather more information on this point and are about to experiment with freshly killed protected species to see if ants can find them when they are placed in a suitable position for protection to act.

List of Species observed with Mutilations.

NYMPHALIDÆ.

| | |
|--------------------|------------------------|
| Hestia lynceus. | Amathusia phidippus. |
| — leuconoë. | Discophora celinde. |
| Ideopsis daos. | Thaumantis lucipor. |
| Euploea midamus. | Junonia atlites. |
| Melanitis leda. | Euthalia derma et spp. |
| — ismene. | Tanaëcia, spp. |
| Mycalesis anapita. | Parthenos gambrisius. |
| — mincus. | Cirrochroa calypso. |
| Ypthima pandocus. | —, sp. |
| — fasciata. | |

PAPILIONIDÆ.

| | |
|-----------------|--------------------|
| Papilio memnon. | Papilio agamemnon. |
| — sarpedon. | — demolion. |

VII. *Conclusions.*

The conclusions to be drawn from these observations are:—

1. Mimicry is a protection from foes which attack butterflies on the wing.
2. Protective resemblance is a protection from foes which hunt sleeping prey.
3. Mimicry was a protection from birds.
4. Birds seldom attack butterflies now, but butterfly-catching birds were formerly more plentiful.
5. The comparative rarity of mimicry shows the danger to have been of relatively short duration.
6. The shyness of butterflies is further proof of danger. It is now probably an inherited instinct.
7. Protective resemblance is almost universal.
8. It is a protection during the sleeping-hours.
9. Ants seldom capture living butterflies.
10. The symmetrical mutilations of butterflies points to lizards and perhaps small insectivorous mammals as the foes which hunt for sleeping butterflies.
11. The amount of danger feared is measurable by the efforts made to avoid it.

LVIII.—*Characters of a new Genus and Species of Cicindelidæ.* By CHARLES O. WATERHOUSE.

AMONG some insects from South Brazil which recently came under my notice were two male examples of a Cicindelid allied to *Oxycheila* and *Raminagrobis*, but which differ from both those genera in the form of the labrum and mandibles; these latter are quite unlike those of any Cicindelid with which I am acquainted and remind one of some species of Lucanidæ.

COPHOGNATHUS.

General characters of *Oxycheila*. Central tooth of the mentum equilaterally triangular, very acute at its apex. Labial palpi very slender, the basal joint extending a little beyond the central tooth, the second joint only a little shorter than the first, the fourth joint a little widened at its apex, rather shorter than the third. Labrum scarcely longer than broad, triangular, denticulate near the apex. Maxillary palpi with the fourth joint a little shorter than the third. Mandibles strong and thick, flattened, curved, with two obtuse approximate teeth near the apex. Thorax, as compared with that of *Oxycheila tristis*, broad, constricted at its base. The anterior tarsi in the male with the three basal joints dilated. Wings present.

Cophognathus opacipennis.

Niger; capite thoraceque nitidis; antennis articulis 5^a–11^m testaceis; elytris opacis, basi punctatis, ad apicem emarginatis. Long. 12 lin.

Hab. São Paulo, South Brazil.

This interesting species has somewhat the appearance of *Oxycheila tristis*, but the small labrum and blunt mandibles are quite different. The eyes are relatively smaller. The thorax is shorter and broader, shining, strongly constricted at the base, with a deep lunate impression on the disk a little in front of the middle, and with the basal transverse impression strongly marked. The elytra are a little shorter, dull, with some not very strong punctures at the base, a few of which are asperate; the apex narrowly truncate (or slightly emarginate), the outer angle of the truncature slightly dentiform. Labrum, mandibles, and tarsi obscurely pitchy.

LIX.—*Some Remarks on the Genus Taphozous.*

By FR. SAV. MONTICELLI.

IN 1885 I proposed the name of *T. perforatus*, var. *assabensis*, for a specimen of bat collected by the late Prof. G. B. Licata in Buia (Assab)*. I have now had the opportunity of comparing my specimen with all the other species of *Taphozous* existing in the collection of the British Museum (Natural History), and I have come to the conclusion that it is identical with *T. nudiventris*, Cretzschmar. Unfortunately I had not seen this species when I described my variety, and I only had before me Mr. Dobson's† synopsis of the subgenera and species, by which I was led astray, as it appears to me to be based on characters of considerable variability.

Dobson divides the genus *Taphozous* into two subgenera easily to be recognized. The first subgenus (*Taphozous*) is characterized by the presence of a radio-metacarpal pouch and by its scarcely grooved lower lip. The second subgenus (*Taphonycteris*) is characterized by the absence of the radio-metacarpal pouch and by the lower lip being divided in the centre of its upper surface and in front by a deep narrow groove. The first subgenus he divided into the *Taphozoi* with radio-metacarpal pouch well developed (*T. melanopogon*, *T. Theobaldi*, *T. australis*, *T. perforatus*, *T. longimanus*, *T. mauritianus*) and those with it small (*T. nudiventris*). But this character of the greater or less development of the pouch is very uncertain, as I have observed in examining all the species of this first group of the genus, and induced me to assign my specimen to the first section, especially as the other character assigned by Dobson to *T. nudiventris* (the length of the forearm) did not agree with it.

I think I have found while examining the different species another character more constant, which enables the members of the two sections of the subgenus *Taphozous* to be easily recognized. This character is the size of the feet—the feet of the *Taphozoi* of the first section being small and those of the species of the second very large. From my observations I think that the synopsis of the species of the genus *Taphozous* might be modified as follows :—

* Ann. Acc. O. Costa d. Aspiranti Naturalisti, Era iii. vol. i. (1885); Bull. Soc. Africana d'Italia, Anno iv. fasc. iv. (1885).

† Cat. of Chiroptera Brit. Mus. p. 379.

Subgenus *TAPHOZOUS*.

Radio-metacarpal pouch distinct; lower lip scarcely grooved.

- A. Feet very large (17-19 millim.); radio-metacarpal pouch generally small; forearm 72-75 millim.; feet with cushions; tragus with a distinct lobule at the base. 1. *T. nudiventris*, Cretzschmar.
- B. Feet small (11-15 millim.); radio-metacarpal pouch well developed.
1. No gular sac; no cushions on the feet.
- a. Ears very large; extremity of tail not thickened; forearm 78 millim., feet 15 millim. 2. *T. Theobaldi*, Dobson.
- b. Ears moderate; extremity of tail thickened; forearm 60-64 millim., feet 12-13 millim. 3. *T. melanopogon*, Temm.
2. Gular sac present, at least in males; feet with or without cushions.
- a. Gular sac present in males, rudimentary or absent in females; throat hairy beneath; feet without cushions; inner margin of the ears papillate.
- a. Gular sac rudimentary in females; outer margin of the tragus rounded; forearm 65-69 millim., feet 11-13 millim. 4. *T. australis*, Gould.
- β. Gular sac absent in females; outer margin of the tragus truncated; forearm 61-63 millim., feet 11-12 millim. 5. *T. perforatus*, Geoff.
- b. Gular sac present in males, rudimentary in females; throat naked beneath; feet with cushions; inner margin of the ears not papillate.
- a. Tragus slender, outer margin truncated; a distinct lobule at the base; forearm 61-63 millim., feet 12-13 millim.; fur above dark brown, beneath paler 6. *T. mauritanus*, Geoff.
- β. Tragus moderate, outer margin rounded, without distinct lobule at the base; forearm 59-63 millim., feet 11-12½ millim.; fur above and beneath varying from reddish brown to black 7. *T. longimanus*, Hardw.

Subgenus *TAPHONYCTERIS*.

No radio-metacarpal pouch; lower lip divided in the centre of its upper surface and in front by a deep narrow groove; inner margin of the ears not papillate; feet without cushions.

- A. Feet large (20-22 millim.); gular sac present in males and females (but smaller in the latter); ears elongated, triangular; tragus without a distinct lobule at the base; forearm 86-89 millim. 8. *T. peli*, Temm.

- B. Feet small (15-18 millim.); gular sac present in males and females; ears large; tragus with a distinct lobule at the base.
1. Gular sac rudimentary in females; the margin alone developed; fur brown above, pure white beneath; forearm 65-67 millim., feet 17-18 millim. . . 9. *T. affinis*, Dobs.
 2. Gular sac developed in females; fur dark brown above and beneath; forearm 71-73 millim., feet 14-16 millim. 10. *T. saccolemus*, Temm.

Another character used by Dobson for the distinction of the different species is the insertion of the wing-membranes; but I have observed that this character is not so valuable as in the Vespertilionidæ, as it is not possible to establish exactly the point of insertion of the wing-membranes.

I am indebted for the opportunity of making these researches to Mr. Oldfield Thomas, who permitted me to use the large material in the British Museum.

British Museum (Natural History),
May 1, 1889.

LX.—On a new Species of Chaffinch.

La Palma, Canaries,
22nd April, 1889.

To the Editors of the *Annals and Magazine of Natural History*.

GENTLEMEN,—In an exploration of this island, in company with Mr. Meade-Waldo, we have collected a large number of the Chaffinch, which invariably differs in its coloration from its congeners in the islands of Teneriffe, Canaria, and Gomera. I venture without hesitation to describe it as distinct, and subjoin the diagnosis.

I am,
Yours faithfully,
H. B. TRISTRAM.

Fringilla palmae, sp. nov.

F. ♂. Fringillæ tintillon similis, sed differt pectore et abdomine albis, nec castaneo-tinctis; mento et thorace rufo-tinctis: et corpore toto superne et cauda schistaceo-cæruleis, nec viridi-tinctis.

♂ juv. supracaudalibus minime viridi-tinctis.

♀ similis fœminæ F. tintillon, sed pallidior.

Hab. In locis sylvestribus insulæ Palma.

LXI.—On a new Species of Tit.

Dehesa de Cologan,
Puerto Orotava,
Teneriffé.
23rd April, 1889.

To the Editors of the *Annals and Magazine of Natural History*.

GENTLEMEN,—I enclose you the description of a marked new species of Tit which I have just discovered in the island of La Palma, the northernmost of the Canarian archipelago. It differs greatly from the Tit of the neighbouring islands both in voice and habitat.

Yours faithfully,
E. G. MEADE-WALDO.

Parus palmensis, sp. nov.

P. ♂. Par. teneriffæ similis, sed differt pectore et abdomine pure albis, nec flavis, sine linea nigra, statura majore, cauda et tarsi longioribus.

♀ mari similis.

Long. tot. 5 poll., alæ 2·45, caudæ 2·3, tarsi ·85–·9 (caudæ *P. teneriffæ* 2·1, tarsi ·7–·75).

Hab. Pinus canariensis in insula Palma.

LXII.—On Zeuglopleurus, a new Genus of the Family Temnopleuridæ from the Upper Cretaceous. By J. WALTER GREGORY, F.G.S., F.Z.S., of the Geological Department, British Museum (Natural History).

ESPECIAL interest now attaches to the genus *Glyphocyphus*, Haimé, since Prof. P. M. Duncan, F.R.S.*, has recently made it the type of the Glyphocyphinae, a subfamily of the Temnopleuridæ. Hence, and as it is the earliest of the Temnopleuridæ to appear, an accurate diagnosis of the genus is essential to a correct appreciation of its relation to its allies. The Glyphocyphinae are characterized by a large apical system with one or more of the radials entering the anal ring, a raised costulate ornamentation, and the absence of pits in

* "On some Points in the Anatomy of the Temnopleuridæ," *Ann. & Mag. Nat. Hist.* ser. 6, vol. i. p. 110.

relation to the sutures. It includes the recent genus *Trigonicidaris*, a good number of extinct Tertiary genera, such as *Arachniopleurus*, *Dictyopleurus*, &c., and the Cretaceous and possibly Oligocene genus *Glyphocyphus*; and to these must be added a new genus to include a series of specimens from the Chalk of Kent and Sussex. Dr. Duncan had examined one of the specimens, and recognizing that it must be assigned to a new genus named it *Zeuglopleurus*; finding that I had also been studying the specimens, he kindly lent me his notes, for which, as they have been of great assistance, I must express to him my best thanks.

The genus *Glyphocyphus* was established by Jules Haime in 1853* for *Tennopleurus pulchellus*, Sorignet†, a species which had even then undergone very varied experiences. He defined the genus as characterized by the possession of crenulate and perforate tubercles, horizontal pairs of pores arranged in a straight vertical series, and with one large tubercle on each plate with its borders strongly "taillés en biseau." This very satisfactory diagnosis was, however, confused by subsequent workers.

Desor redescribed the genus in 1856‡, and stated, among other generic characters, that the tubercles were neither crenulate nor perforate, neither of which features were indicated in his specimens, as they are often difficult of recognition in badly preserved material. Desor, however, attached little value to the absence of crenulations and emphasized the sutural impressions, which had been overlooked by previous observers except Sorignet, as the essential character; in consequence he brought into the genus a series of species previously distributed between *Arbacia*, *Cyphosoma*, and *Echinopsis*; he showed, moreover, that Sorignet's *T. pulchellus* was the same species as the *Echinus radiatus*, Höninghaus, which is therefore the type, while *Tennopleurus pulchellus*, with *Echinopsis depressa*, Ag., and *Echinopsis latipora*, Ag., must be reduced to synonyms, amongst which Desor also reckoned *Echinopsis pusillus*, Römer.

Later in the same year Dr. S. P. Woodward§ corrected Desor's error as to the absence of crenulation and perforation in the tubercles of the type species of *Glyphocyphus*,

* D'Archiac and Jules Haime, 'Description des animaux fossiles du groupe nummulitique de l'Inde,' t. i. (Paris, 1853), p. 202.

† 'Oursins fossiles de deux arrondissements du département de l'Eure (Vernon, 1850), pp. 31-33.

‡ 'Synopsis des Echinides fossiles,' feuille 13 (1856), pp. 102-104, pl. xvii. figs. 1-5.

§ Decades Geol. Surv. no. v. (London, 1856), Appendix, p. 3.

and agreed* with Desor in regarding *Echinopsis pusillus*, Roem., as a synonym of *Temnopleurus pulchellus*, and consequently of *Glyphocyphus radiatus*, though, as we shall subsequently see, on this point both authors were probably in error. Dr. S. P. Woodward, however, differed from Desor as to the true nature of *Glyphocyphus difficilis* (Ag.), which he returned with its synonyms, *Diadema rotatum*, Fbs., *D. M'Coyi*, Fbs., and *D. rotulare*, M'Coy, not Ag., to its original position in *Cyphosoma*, on account of the structure of the apical disk, which, according to him, was quite different from that of *Glyphocyphus*, though it is equally unlike that of *Cyphosoma*. He recognized the grooved sutures, but regarded this feature as of but specific value.

In 1859 MM. Cotteau and Triger gave† admirable descriptions and figures of *G. radiatus*, and to the list of synonyms they added, though with a query, *Glypticus Konincki*, Fbs. non Des. This query was omitted by M. Cotteau in a subsequent list; that he was justified in so doing must be admitted, as there can be no doubt that the figure given by Forbes as *Glypticus Konincki*‡ is only that of the abactinal view of the specimen of which the actinal view is given in the adjoining figure described as *Echinopsis pusillus*. Forbes's specimen, now in the British Museum, probably belongs to neither species, as we shall see subsequently. In 1860 MM. Cotteau and Triger, in a later sheet of their work§, separated those of Desor's species of *Glyphocyphus* of which the tubercles were really imperforate as their new genus *Echinoocyphus*, having *E. tenuistriatus* (Des., non. Ag.) as the type.

The discovery of many specimens of the type species of *Glyphocyphus* in the Cénomanien of Algeria next occasioned contributions to the literature of the species, and in 1862 Coquand|| recorded it as *Temnopleurus pulchellus*, though its correct name was given by Peron in 1866, when he described¶ two varieties, a large subpentagonal one from

* "A Note on *Echinopsis*," Dec. Geol. Surv. no. v. (London, 1856), pl. iii. p. 6.

† 'Echinides du département de la Sarthe,' feuille 10 (Paris, 1859), pp. 158-162, pl. xxviii. figs. 7-12.

‡ Dixon, 'The Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex' (London, 1850), p. 340, pl. xxv. figs. 30, 31.

§ *Op. cit.* feuille 15, 1860, pp. 226, 227, pl. xxxix. bis, figs. 3-6.

|| 'Mém. de la Soc. d'Émul. de la Provence' (Marseilles, 1862), t. ii. p. 294.

¶ "Notice sur la géologie des environs d'Aumale (Algérie)," Bull. Soc. Géol. France, sér. 2, t. xxiii. 1866, pp. 697, 698, 703.

the zone à *Radiolites* and a var. *minor*, a small round form, from the zone of *Epiaster Heberti*, Coquand.

M. Cotteau had shortly before this published his principal contributions to the literature of *Glyphocyphus* and *Echinocyphus*; in the 'Paléontologie Française' he gave elaborate descriptions and figures of the former genus in 1864 * and of the latter in 1865 †. He then incorporated the type and several other species of *Hemidiadema*, Ag., in *Glyphocyphus*. In 1865 he redescribed and figured ‡ the *contexta* variety of *Glyphocyphus radiatus*.

Dr. Wright, in 1870 §, was the next palæontologist to describe and figure the genera, and his most important contribution to our knowledge of their structure was that, though in his generic diagnosis of *Echinocyphus* he described the apical disk as unknown, he nevertheless figured and described that of *E. difficilis* ||.

The Algerian specimens of *Glyphocyphus radiatus* were again described ¶ by MM. Cotteau, Peron, and Gauthier in 1879, and in 1879 Prof. K. von Zittel pithily summarized the two genera **, but described the furrowed sutures of *Echinocyphus* as limited to the median interambulacral suture, and those of *Glyphocyphus* as affecting also the horizontal ones, whereas the horizontal sutures of *Echinocyphus* are more markedly furrowed than those of the other genus, as can be seen in Wright's drawings or in his specimens. Dr. Schlüter in 1883 redescribed *E. pusilla*, Rœm., and included it in *Echinocyphus*; and as he leaves *E. pusilla*, Münst., in the same genus, has renamed Rœmer's species *Echinocyphus pisum*; as, however, this belongs to *Zeuglopleurus*, the original name will stand. Finally Pomel, in 1883 ††, has insisted that in *Glyphocyphus* the furrowing of the sutures is limited to a couple of fossettes under the primary tubercles; this is

* Paléont. Française, Terr. Crét. t. vii. feuilles 34, 35 (1864), pp. 531-546, pls. 1127, 1128.

† *Op. cit.* feuille 45 (1865), pp. 707-716, pls. 1174, 1175.

‡ 'Etudes sur les Echinides fossiles du département de l'Yonne,' feuille 16 (1865), pp. 230-233.

§ 'Monograph of the British Fossil Echinodermata from the Cretaceous Formations,' vol. i. pt. 3. Palæontogr. Soc. 1870 [1869], pp. 116-124, pl. xxii. figs. 1-4, pl. xxix B. figs. 1, 2.

|| *Loc. cit.* pl. xxii. fig. 4.

¶ 'Echinides fossiles de l'Algérie,' t. i. fasc. 5 (Paris, 1879), pp. 205-207.

** 'Handbuch der Palæontologie,' Bd. i. pp. 503, 506.

†† 'Classification méthodique et genera des Echinides vivants et fossiles' (Alger, 1883), p. 103.

certainly not the case in the original figure of the type, though it must be admitted that the general facies of this figure more resembles that of *Echinocyphus* than of *Glyphocyphus*; but as the question cannot be decided without an examination of the lost type specimen, it is best to accept it in the sense that has been done by all palæontologists who have written upon it. M. Pomel moreover separates * from *Echinocyphus* the species *E. difficilis* and *E. rotatum* as the genus *Glyptocyphus*, owing to the compound ambulacral plates of those species consisting of four or five primaries.

This examination of the literature of the genus *Glyphocyphus* is necessary owing to the confusion that prevailed over the type species since its definition by Höninghaus in 1820 † till at least as late as 1870, when Nicaise still quoted ‡ *T. pulchellus*, Sorignet. Even in 1875 Quenstedt published § a diagnosis of *Glyphocyphus* in which he described the tubercles as imperforate and non-crenulate. From it, moreover, we learn that all recent authors have accepted the two genera *Glyphocyphus* and *Echinocyphus* as distinct, and their differences may be summarized as that in *Glyphocyphus* (i.) the tubercles are perforate, (ii.) the apical disk is a narrow ring of plates all of which enter the anal ring, and (iii.) that the furrowing of the sutures is less prominent; whereas in *Echinocyphus* (i.) the tubercles are imperforate, (ii.) the apical disk more solid, the paired basals meeting and pushing the anus posteriorly, and (iii.) there is more prominent furrowing of the sutures.

The specimens upon which this new genus is founded have apparently been regarded as *Glyphocyphus radiatus*, which they resemble in ornamentation, and have thus been overlooked by all previous observers except Römer.

ZEUGLOPLEURUS, n. gen.

Test (figs. 1-3, p. 500) small, globular, circular, depressed below, slightly conical above; sides tumid. Tubercles arranged in one or two vertical rows in each ambulacrum, slightly smaller than those of the two rows in each interradius.

Apical disk (fig. 2) somewhat solid, the two postero-lateral radials enter the anal ring; the antero-lateral pair of basals

* *Op. cit.* p. 87.

† Goldfuss, 'Petrefacta Germaniæ' (Dusseldorf), pp. 124, 125, pl. xl. fig. 13.

‡ 'Catalogue des animaux fossiles de la province de l'Algérie,' p. 67.

§ 'Petrefactenkunde Deutschlands,' Bd. iii. (Leipzig, 1875), p. 692.

meet the adjoining basals on each side of them, and thus the antero-lateral and anterior radials are excluded from the anal ring, while the anus is pushed towards the posterior side; the posterior basal is very narrow. All the ten plates are perforated.

Ambulacra (figs. 3 and 5) somewhat narrow and straight. Each bears one or two rows of primary tubercles, which are crenulate and imperforate and surrounded by small scrobicular areas, broken by series of radiating costulate ridges which unite with those of the adjoining plates above and below. The rest of the plate is covered with miliary granules arranged with some regularity. The horizontal sutures are notched by grooves, much as in *Glyphocyphus*, which affect especially the adoral edge of the plates, so that the lower plate projects above the upper one.

Structure of the poriferous zones (fig. 5).—The pairs of pores are in single rows, which are nearly straight. The plates nearest the disk are primaries, but, proceeding actinally, they become fused to form compound plates of two or three primaries; a single primary is often intercalated between two compound plates.

Interambulacra (fig. 4) about one and a half times as wide as the ambulacra; the epistroma is similar to that on the ambulacral plates, but is still more developed; a single row of primary tubercles occurs on each side of each interradius; the tubercles are connected by costulate ridges, and the rest of the plate is covered by very crowded large miliary granules; a small row of secondary tubercles may be developed in the aboral external corner of each plate. The tubercles are imperforate and crenulate.

Mouth about equal in size to the apical disk, with very small branchial slits.

Distribution. Upper Cretaceous of England and Germany; France?

1. *Zeuglopleurus costulatus*, sp. nov. (fig. 1).

Test small, turban-shaped, depressed, sides tumid. Actinally concave; abactinally depressed. Circular at the ambitus, but slightly elongated in the direction of the antero-posterior axis.

Apical system rather large and oval. The unpaired basal is very narrow. The paired basals are (especially the antero-lateral) much larger, and meet within to push the periproct posteriorly; all the basals are much pitted and tuberculate; but the madreporite is distinct on the right antero-lateral basal. The radials are small.

Ambulacra narrow, straight, slightly raised. Each plate bears a single prominent tubercle, from the boss of which radiates a series of costulate ridges, usually seven in number, some of which unite with the ridges of the adjoining plates. Between the ridges are series of miliary granules and sometimes a very small secondary tubercle.

The pairs of pores are in primaries for the first few youngest plates; these are succeeded actually by compound plates formed of two primaries and are usually separated by simple primaries; compound plates of triple primaries occur more rarely.

Interambulacra of vertical series of about ten or eleven plates, ornamented by tubercles, miliary granules, and costulate ridges. The primary tubercles form two rows, one on each side of each interradius, and resemble those of the ambulacra, which they slightly exceed in size. Near the ambitus each plate bears a secondary tubercle. The bosses of the primary tubercles are connected by costulate ridges, which intersect the scrobicular areas; the vertical costæ are the most prominent and form a vertical ridge, the two aboral costæ of one plate uniting with the adoral single costa of the plate above. The miliary granulation is prominent and crowded.

The horizontal sutures are furrowed, the furrow most affecting the adoral side of the two plates, so that the aboral projects above the former.

Peristome small, circular or very slightly oval, with small branchial slits; the margin of the ambulacra occupies less of the circle than that of the interambulacra.

Dimensions.

| | millim. |
|----------------------------------|---------|
| Diameter, antero-posterior | 11 |
| „ transverse | 10.5 |
| Height | 6 |
| Diameter of apical disk | 4 |
| „ „ anus | 2 |

Ratio of ambulacra to interambulacra 5:8.

Distribution. Mid Chalk of Charlton, in Kent, and Chalk-Marl of Glynde, in Sussex. (British Museum.)

2. *Zeuglopleurus pusillus* (Roem.).

1840. *Echinopsis pusilla*, Roem., Versteinerungen des norddeutschen Kreidegebirge, p. 30, pl. vi. fig. 10.

1840. *Echinopsis pusilla*, Bronn, not *E. pusilla*, Rœm., of Forbes, Desor, &c.

1883. *Echinocyphus pisum*, Schlüter, "Die regulären Echiniden der norddeutschen Kreide," Abhandl. geol. Specialkarte v. Preussen und den Thüringischen Staaten, Bd. iv. Heft. 1 (Berlin, 1883), pp. 49, 50.

Rœmer defined * Agassiz's genus *Echinopsis* as "Wie *Arbacia*, aber die Zwischenfehlerfelder mit einer Längsfürche;" and of this he described a new species, *E. pusilla*. Only four lines above this he described *E. radiatus*, Kön., which he referred to a different genus and group of genera, and recognizing such structural differences between them as to preclude the necessity for closer comparison. Bronn, in the same year †, adopted Rœmer's decision and kept *Arbacia radiata* (Kön.) and *Echinopsis pusilla*, Rœm., as quite separate. Geinitz in 1850 took ‡ exactly the same position. Forbes in 1850 § described the abactinal figure of his so-called *Glypticus Könincki* (really a Lower Oolite species) as *E. pusilla*, Rœm., though the structure of the abactinal surface is quite different; his specimen, now in the British Museum, is a true *Glyphocyphus radiatus*. Bronn in 1852 ||, possibly trusting to the accuracy of Forbes's identification, gave a figure resembling that of Forbes which he also referred to *E. pusilla*, Rœm.; but in both these cases all the radials enter the anal ring, and thus are true *Glyphocyphus*. Desor followed these authors, and henceforth *E. pusilla*, Rœm., appears in all lists of the synonyms of *G. radiatus*. Unsatisfactory though Rœmer's figure may be as to general details, it clearly shows the structure of the apical disk, in which only two radials enter the anal ring, the others being excluded by the ingrowth of the paired basals, as in *Zeuglopleurus*.

We must therefore conclude that Rœmer was fully justified in separating his species from *E. radiatus*, and it only remains to consider its differences from *Z. costulatus*. It differs from this, so far as Rœmer's figure and description enable us to compare them, in several important points: thus the base is much flatter and the abactinal side more conical; the central part of the apical disk is raised, so that on a posterior eleva-

* 'Die Versteinerungen des norddeutschen Kreidegebirges' (Hanover, 1840), p. 30, pl. vi. fig. 10.

† 'Index palæontologicus, A. Nomenclator palæontologicus,' Heft i. pp. 91 and 447 (Stuttgart, 1848).

‡ 'Das Quadersandsteingebirge oder Kreidegebirge in Deutschland' (Freiburg, 1850), pp. 222, 223.

§ Forbes, *loc. cit.* p. 340, pl. xxv. fig. 31.

|| 'Lethæa geognostica,' Bd. ii. Th. v. (Stuttgart, 1852), p. 187, pl. xxix.⁷ figs. 9 a, b.

tion the anus can be seen above the unpaired basal, whereas in *Z. costulatus* it is then hidden.

3. *Zeuglopleurus* (?) *cannabis* (Des.), 1858.

1858. *Glyphocyphus cannabis*, Desor, Syn. p. 450.

1864. *Glyphocyphus cannabis*, Cott., Pal. Franç. Terr. Crét. t. vii. p. 545.

1865. *Glyphocyphus cannabis*, Cott., Études sur les Échinides fossiles du département de l'Yonne, feuille 16, pp. 232, 233 (footnote).

This species, briefly described by Desor in the appendix to his 'Synopsis,' has never since been met with. Cotteau retains it on Desor's authority in the 'Paléontologie Française,' but merely quotes the founder's description; and he again refers to it in the 'Ech. Fossiles de l'Yonne.' The specific diagnosis is that "the tubercles are less conjugate; the apical system is also less annular." The latter character renders it probable that the apical system was as in *Zeuglopleurus*; but if so, the former will readily distinguish it from *Z. costulatus*.

The Affinities and Differences of the Genus Zeuglopleurus.

—The two nearest allies of *Zeuglopleurus* are its contemporaries *Glyphocyphus* and *Echinocyphus*. The main features that ally it to the former are the deep grooves under the tubercles, and the resemblance of the epistroma, the general facies of which is the same, though differing in details. It is, however, clearly distinguished from this genus by the imperforate nature of the mamelons and by the fact that only two of the radials enter the anal ring (fig. 6). To *Echinocyphus* it is probably nearer, though its general appearance is more dissimilar; it agrees in the non-perforation of the tubercles; from it, however, it is distinguished by the absence of the horizontal regular sutural furrows, which are replaced by fossettes, by a much greater development of epistroma, and by the structure of the apical disk (fig. 7), which is oval in *Zeuglopleurus* and subpentagonal in *Echinocyphus*; in the latter, moreover, the postero-lateral as well as the antero-lateral basals unite across the middle of the apical disk, and there form a basal mass that pushes the periproct far posteriorly. Another genus to which *Zeuglopleurus* is allied is *Dictyopleurus*, Dunc. & Slad. *, from the Eocene of Sind, in which the apical

* Duncan and Sladen, 'Palæontologia Indica,' ser. xiv. vol. i. pt. 3, fasc. ii.: "The Fossil Echinoidea from the Ranikot Series of Nummulitic Strata in W. Sind" (London, 1882), p. 38, pl. ix. fig. 2.

disk has the same arrangement, but is more regular. *Zeuglopleurus* differs from this by its imperforate tubercles, the distribution of the epistroma, and the absence of the obliquity of the apical disk so well marked in *Dictyopleurus*. In *Zeuglopleurus* the arrangement agrees with that of *Evechinus** and other genera, with which, however, it has but little in common, while that of *Echinocyphus* may be compared to that of a *Pygaster* in which the posterior basal has not been completely absorbed by the backward passage of the anus. The three genera in fact form a series in which we may see the same tendency towards the retrogression of the anus that is so noticeable in the *Petalosticha* and the *Clypeastroidea*. In *Glyphocyphus* the anus is central; in *Zeuglopleurus* it has travelled backwards and the antero-lateral basals have expanded to fill the space thus caused. In *Echinocyphus* the same process has continued and the postero-lateral basals have also met across the centre, and thus the anal ring, instead of being constituted by the ten plates as in *Glyphocyphus*, or seven as in *Zeuglopleurus*, is limited to three. The process, however, seems to have stopped here, and in the Tertiary genera the apical disk is on the *Zeuglopleurus* type, though the arrangement is far more regular.

The evidence for the validity of this new genus seems quite sufficient, and Prof. Duncan proposes to accept it in his forthcoming 'Revision of the Genera of Echinoidea.' The only discovery that could shake it would be that the apical disk of *Echinocyphus* is normally different from that of the specimen of *E. mespilia* in the British Museum and the figure of *E. difficilis* given by Wright. This is the only evidence available at present, as M. Cotteau informs me that the apical disk has not yet been discovered in any French specimen, and, except for a doubt as to the specific determination of Wright's figure, there seems no reason to distrust it. The evidence in the case of *Zeuglopleurus* is much stronger; the specimens in the British Museum collection are admirably preserved and come from different localities and horizons, and are in different stages of growth, from some as small as any of *Glyphocyphus radiatus* to the type, which is larger than any of that species, and they agree absolutely in the important points of structure.

* *Evechinus chloriticus* (Val.), Al. Agassiz, "Revision of the Echini," Mem. Mus. Comp. Zool. Cambridge, Mass., 1873, pp. 502, 503, pl. iv. b. fig. 7. *E. rarituberculatus*, Bell, "Description of a new Species of *Evechinus*," Ann. & Mag. Nat. Hist. ser. 5, vol. xx. 1887, pp. 403-405, pl. xvii. figs. 7 and 8.

Fig. 1.

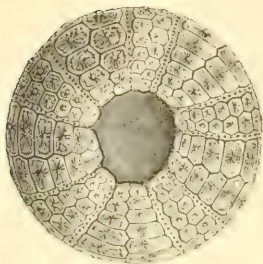


Fig. 2.

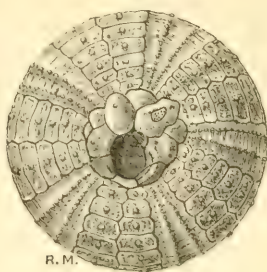


Fig. 3.

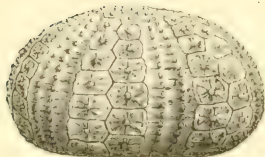


Fig. 4.



Fig. 5.



Fig. 6.

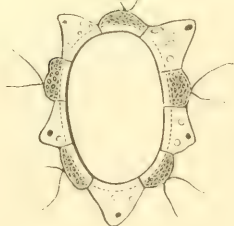


Fig. 7.



EXPLANATION OF THE FIGURES.

- Fig. 1.—*Zeuglopleurus costulatus*, n. sp. Lower Chalk, Glynde, Sussex.
Actinal view, $\times 3$ diams. Brit. Mus.
Fig. 2.—Ditto. Abactinal view, $\times 3$ diams.
Fig. 3.—Ditto. Side view, $\times 3$ diams.
Fig. 4.—Ditto. Interradial plates, mag.
Fig. 5.—Ditto. Structure of ambulacra.
Fig. 6.—*Glyphocyphus radiatus* (Hön.). Apical disk, after Cotteau.
Fig. 7.—*Echinocyphus difficilis*. Apical disk, after Wright.

LXIII.—*Descriptions of new Species of Phasmodæ from Dominica, Santa Lucia, and Brazil (Theresopolis), in the Collection of the British Museum.* By W. F. KIRBY, Assistant in the Zoological Department, British Museum (Natural History).

THE bulk of the species described in the present paper were collected by Mr. Ramage; but I take the present opportunity of adding the description of a remarkable new genus and species lately received from Herr Fruhstorfer from Theresopolis. In addition to the new species, Mr. Ramage's collection contained two damaged specimens apparently referable to *Bacunculus haita*, Westw., and *Bacteria calamus*, Fabr., from Santa Lucia. There were also several specimens of *Pseudobacteria antillarum*, Sauss.*, originally described from Guadeloupe. In the specimens from Dominica the antennæ are yellow for one third of the distance from the base, the rest being brown alternating with yellow spaces. In one specimen the four subapical spines on the middle and hind tibiae are wholly absent on the right side, though on the left side the legs are armed as usual.

Diapheromera (?) Saussurii.

Male.—Long. corp. 62 millim.; thor. 25; mesoth. 15; metath. 10; abd. 25.

Size and appearance of *D. Sayi*, Gray; brown, finely granulated, the sutures and a lateral groove, not visible from above, running along the whole length of the body. Antennæ slender, as long as the body. Legs slender, the middle femora not thickened, about as long as the metathorax; middle tibiae of equal length; first joint of middle tarsi as long as the three following, the second one third as long, the third and fourth successively shorter, the fifth pear-shaped and (without the claws) nearly as long as the second; the front and hind legs are a little longer than the middle ones, and the first joint of their tarsi is longer in proportion; the four hind femora are armed with a small tooth beneath before the extremity. Head about as long as the prothorax, with a slight groove in the median line; two small horns between the eyes. Prothorax with deep longitudinal and transverse grooves, forming a cross. The three terminal segments of

* *Bacteria antillarum*, Sauss. Rev. Zool. 1868, p. 65; Miss. Mex. vi. p. 157 (1870).

the abdomen raised and thickened; cerci very large and crossing each other, as in *D. Sayi*.

Hab. St. Michael, Dominica.

I have preferred to place this insect in *Diapheromera* rather than *Bacunculus* on account of the structure of the cerci, although the middle femora are not thickened. If it is regarded as more properly belonging to *Bacunculus*, its proper place would be near *B. olmeca*, Sauss., in which the head is likewise cornuted; but *B. olmeca* is smaller, the abdomen is hardly granulated, and the legs are unarmed, apart from other differences.

Pterinoxylus crassus.

Long. corp. (absque operculo) 160 millim.; thor. 68; mesoth. 35; metath. 20; abd. 86; long. tegm. 16; al. 26.

Female.—Reddish brown (colours altered); antennæ stout, as long as the mesothorax; head and thorax strongly granulose; thorax and abdomen with traces of two contiguous lateral black stripes. Head greyish on the vertex; mesothorax with a strong lateral groove extending its whole length to the base of the tegulæ, and another on its lower surface terminating within the middle coxæ; metathorax with a very strong transverse depression above just behind the wings. Metathorax and abdomen hardly granulated above, abdomen with the spiracles placed on a wart at the base of each segment and very conspicuous; below them runs a rather irregular longitudinal row of small warts, and towards the middle of the abdominal segments beneath, the surface is more granular and wrinkled; sixth segment very slightly expanded. Operculum short and broad. Legs of about uniform length; front femora and tibiæ flattened, with large irregular serrations and foliations; middle femora with several large teeth, and strongly lobate towards the extremity, with a strong notch above near the base; hind femora with a row of very small teeth below, with three or four still smaller ones in each interspace, and a very large lobe near the extremity above, projecting behind in a point, below which are three shorter teeth; hind tibiæ with a similar but smaller lobe, with only two teeth. All the tarsi blackish. Tegmina humped and with a large black spot in the middle. Wings with the costal area reddish, a smooth oval space at the base, probably vitreous in fresh specimens, the remainder smoky semitransparent brown, the nervures marked with short black stripes alternating with interrupted transverse rows of white spots.

Hab. Dominica (March 1889).

A remarkable insect, allied to *P. difförmipes*, Serv., but much stouter and abundantly distinct.

Pseudobacteria longiceps.

Long. corp. 98 millim. ; thor. 36 ; mesoth. 21 ; metath. 7 ; abd. 50 ; fem. ant. 24 ; interm. 18 ; post. 26 ; lat. mesoth. 3.

Female.—Reddish brown, indistinctly mottled and granulated with blackish above, which makes it look darker ; head longer than the mesothorax, with a black groove in the median line ; antennæ blackish, indistinctly annulated with paler ; thorax strongly longitudinally carinated, especially on the sides and beneath ; legs paler than the upper surface of the body, indistinctly ringed with blackish ; the coxæ, the tips of the hind tibiæ, and the last four joints of their tarsi more distinctly black (front tarsi broken off). Mesothorax with a moderate-sized black spot at the extremity above ; hinder lobe of the metathorax extremely short. Abdomen with segments one to six of nearly equal length, the neighbourhood of the suture of the fourth and fifth segments and the last three segments paler than the rest. The segments are of about equal width throughout as far as the sixth, which narrows from its base to its extremity ; the last three are much narrower than the others, and only about two fifths as long, being not much longer than broad. Cerci rather small.

Hab. Santa Lucia.

ABRACHIA, nov. gen.

Female.—Apterous, elongated, smooth.

Head long, oval ; antennæ 22-jointed, the first joint large, broadest at the tip, the second narrower, not much longer than broad, the third narrower, cylindrical, much longer than broad, and followed by a closely connected series of transverse cheese-shaped joints, which become longer and more distinctly separated towards the extremity. Prothorax hardly as long as the head, with a transverse crescent-shaped impression on the centre. Mesothorax about half as long again as the metathorax, which latter is marked with a transverse suture. Abdomen cylindrical, the joints (except the last two) much longer than broad. Operculum extremely long, cerci &c. short. Legs carinated, femora spined, and four hind tibiæ lobed.

A singular genus, with much shorter antennæ than any

Phasma previously described from the New World. In the shape of the head it resembles *Lonchodes*; but the serrated front femora would recall *Acrophylla*.

Abrachia brevicornis.

Length, from head to extremity of abdomen (not including operculum) 162 millim.; length of operculum beyond abdomen 30; length of head 9; prothorax 6; mesothorax 33; metathorax 26; abdomen 88; (antennæ in a smaller specimen 8 millim.).

Greenish brown; colour during life probably green. Front femora strongly serrated on both sides for two thirds of their length; front tibiæ unarmed. Serrations of the four hind tibiæ smaller and extending for two thirds of the length on the outside and for one third on the inside; four hind tibiæ with one (rarely two) large triangular tooth-like lobes on the under surface. All the femora rather longer than the tibiæ; first joint of tarsi as long as or longer than all the rest together.

Hab. Theresopolis, Brazil.

Two specimens, both females; the second is one sixth smaller than the type.

BIBLIOGRAPHICAL NOTICES.

Report upon the Crinoidea collected during the Voyage of H.M.S. 'Challenger' during the Years 1873-76.—Part II. *The Comatulæ.* By P. HERBERT CARPENTER, D.Sc., F.R.S., F.L.S., Assistant Master at Eton College. Pp. i-ix, 1-399; 70 plates. [*Report on the Scientific Results of the Voyage of H.M.S. 'Challenger.'*—Zoology, part lx.] Published by Order of Her Majesty's Government, 1888.

THE masterly monograph on the Stalked Crinoids by Dr. P. Herbert Carpenter, which was noticed in this Journal*, justly caused the appearance of the Report on the Comatulæ to be looked for with great anticipation. This work has recently been published, and the most sanguine expectations will be found to have been in no way disappointed.

Until recently the Comatulæ have been singularly neglected by naturalists. This circumstance was due partly perhaps to the difficulties of study and partly to the comparative scarcity of specimens. Before the work of Dr. Carpenter the classification of the known

* Ann. & Mag. Nat. Hist. ser. 5, vol. xv. p. 346.

forms was hardly possible, and the descriptions of the majority were so insufficient and unsatisfactory that working collectors may well be pardoned for shrinking from naming additional specimens acquired from time to time. Thanks to the author of the present monograph this chaos is now dispelled, and light is at last admitted into the domain of these interesting organisms.

The Report is divided into the seven undermentioned sections:—
 I. General Introduction, in which a historical sketch is given of our knowledge of the Comatulæ. II. The Centro-Dorsal and Calyx, which gives a comparative morphological review of the principal characters which distinguish the Comatulidæ from the other Crinoids, and discusses the opinions of previous writers thereon. III. Gives a summary of the Geographical and Bathymetrical Distribution of the Comatulæ. IV. Treats of the Geological History of the Comatulæ. V. Deals with Classification, in which the author discusses the validity and relative value of the characters used for specific determination, and proposes a system of literal formulæ by which the characters of the species may be indicated, the method adopted by Bell in 1882 being discussed and improved. VI. Is devoted to the description of the specimens, and occupies three fourths of the Report; each genus is exhaustively discussed, and tabular keys are given of the species included in each genus or section of a genus. VII. Bathymetrical Distribution and Station List, to which is added a list of the known living species of Comatulæ.

The following brief epitome will indicate the main results arrived at in the Report.

The family Comatulidæ (d'Orbigny) as amended by the author now comprises seven genera, the general relations of which are expressed in the following table:—

- I. Centro-dorsal has no articular facet on its lower surface.
 - A. Five rays.
 - i. Mouth central or subcentral. Oral pinnules have no comb.
 - a. Radials separated by interradials. *Thaumatoctrinus*.
 - b. Radials united laterally.
 - (1). Basals persist as a closed ring. No pinnules on lower brachials. *Atelecrinus*.
 - (2). Basal ring incomplete or invisible externally.
 - a. Five arms only *Eudiocrinus*.
 - β. Ten arms. *Antedon*.
 - ii. Mouth excentric or marginal. Oral pinnules have a terminal comb *Actinometra*.
 - B. Ten rays *Promachocrinus*.
- II. Centro-dorsal has an articular facet below *Thiolliericrinus*.

The two genera *Thaumatoctrinus* and *Promachocrinus* were discovered by the 'Challenger.'

Thaumatoctrinus, Carpenter, is a remarkably archaic form, characterized by persistent basal and oral plates—the latter occurring in no other Comatulid; primary interrarial plates which separate the radials are also present. It is represented by one species, which has been found only in the Southern Ocean at a depth of 1800 fathoms.

Atelecrinus, Carpenter, is characterized by the persistence of the embryonic basals, which do not undergo transformation into a rosette, and by the absence of pinnules from the lowest joints of the arms, characters which mark the genus as a permanent larval form. Three species are known, two from the Atlantic and one from the Pacific. One of the Atlantic species occurs off Havana in 450 fathoms, and the other in the Caribbean Sea and off Pernambuco in depths ranging from 291 to 422 fathoms. The Pacific species was dredged near Fiji in 610 fathoms.

Eudiocrinus, Carpenter, has a centro-dorsal and calyx like those of *Antedon*; but the radials bear the brachials directly without the intervention of axillaries, so that there are only five undivided arms. Five species are known, four from the Western Pacific (off Japan, the Philippine Islands, South-east Australia, and New Zealand, in depths varying from shallow water to 1050 fathoms) and one from the Atlantic, at about 45° N., from 486 fathoms.

Antedon, de Fréminville, contains the large number of 120 recent species. These have been separated by the author into groups or alliances of species, determined by the character of the rays and of their subdivisions. The groups are not only well defined as regards their morphological characters, but are also more or less definitely limited in their distribution both bathymetrical and geographical. Four series and ten groups are defined, the latter being named after the first described or most characteristic species. These divisions of the genus may be thus tabulated:—

- I. The two outer radials united by syzygy *elegans*-group.
- II. The two outer radials articulated; ten arms.
 - a. The radials and brachials have flattened sides.
Pinnule-ambulacra generally plated *basicurva*-group.
 - b. The rays not flattened laterally. Pinnule-ambulacra well plated *acala*-group.
 - c. The first two or three pairs of pinnules long and flagellate, with numerous short and wide joints *Eschrichti*-group.
 - d. The joints of the lowest pinnules, which are often long and slender, are longer than wide, frequently very much so *tenella*-group.
 - e. The first pair of pinnules are comparatively small and their joints but little longer than wide; one or more of the second, third, and fourth pairs are longer and more massive, with stouter joints than their successors. *Milberti*-group.

III. Two articulated distichals; multibrachiate.

- a. Bidistichate species with the radial axillaries and some of the following joints more or less wall-sided and a well-marked ambulacral skeleton on the pinnules *spinifera*-group.
- b. Bidistichate species with an unplated disk and no definite ambulacral skeleton. Sides of brachials scarcely if at all flattened. First pinnule smaller than its successors *palmata*-group.

IV. Three distichals, the first two articulated and the third axillary with a syzgy.

- a. Tridistichate species with plated ambulacra and the lower part of rays flattened laterally *granulifera*-group.
- b. Tridistichate species with unplated disk and no definite ambulacral skeleton; bases of rays not flattened laterally *Savignyi*-group.

1. The *elegans*-group comprises three species and their distribution is limited to shallow water in the Eastern Archipelago.

2. The *basicurva*-group embraces twenty-two species, all of which, with the exception of one from the Southern Sea and four from the Atlantic, inhabit the western Pacific and Australasia; and all belong to the continental or abyssal zone, ranging from 140 to 1600 fathoms, excepting one species from 49 fathoms in the Arafura Sea.

3. Of the *acela*-group only two species are known, one from 140 fathoms in the Arafura Sea and the other from 500 fathoms off the Meangis Islands.

4. The *Eschrichti*-group contains seven species, three of which are arctic and four antarctic. The arctic species extend between the parallels of 43° N. in the Atlantic and 81° N. in Smith's Sound. Two of the antarctic species occur in the Strait of Magellan and the other two between Kerguelen and Heard Island. Only two of the species are found at depths greater than 200 fathoms, one extending to 466 and the other to 632 fathoms.

5. The *tenella*-group comprises twenty-three species, most of which inhabit the Atlantic and circumpolar seas, one extending to the parallel of 81° N. Five species only occur in the Pacific, four of them ranging between 150 and 775 fathoms, whilst the fifth (from the North Pacific) was from a depth of 2900 fathoms. The same species was also obtained in the Southern Ocean at 2600 fathoms. (These were the two deepest stations at which Comatulæ were met with.) Two other species were also obtained in the Southern Ocean at 1600 fathoms.

6. The *Milberti*-group contains fourteen species, all of which are limited to the Pacific and the Eastern Archipelago, with the exception of one which extends into the Indian Ocean, Red Sea, and Western Atlantic. This was dredged off St. Lucia in 278 fathoms, but all the other members of the group are confined to the littoral zone, most of them inhabiting depths not exceeding 20 fathoms.

7. The *spinifera*-group embraces eleven species which occur in the Caribbean Sea and Eastern Archipelago, predominating in the former. Their bathymetrical range is from 35 to 740 fathoms.

8. The *palmata*-group contains twenty-three species, which are limited exclusively to the Western Pacific and Indian Ocean, ranging northward as far as South Japan, but not extending southward beyond the tropic of Capricorn. All belong to the littoral fauna excepting one species dredged between 210 and 610 fathoms.

9. The *granulifera*-group includes six species which have essentially the same distribution, both bathymetrical and geographical, as the *basicarva*- and *spinifera*-groups, which are also distinguished by wall-sided rays and an ambulacral skeleton.

10. The *Savignyi*-group embraces ten species, which are found in the Western Pacific as far north as Hong Kong and Japan, the Eastern Archipelago, and the Indian Ocean westward to the Red Sea. All belong to the littoral zone, one only extending to 140 fathoms in the Arafura Sea.

Actinometra (Müller), as amended by the author, contains forty-eight recent species, which are divided into series and groups, as shown in the following table:—

- I. The two outer radials and the first two brachials respectively united by syzygy.
 - a. Ten arms *solaris*-group.
 - b. Two distichals united by syzygy *paucicirra*-group.
 - c. Three distichals, the axillary a syzygy *typica*-group.
- II. The two outer radials articulated. Ten arms .. *echinoptera*-group.
- III. Two articulated distichals.
 - a. The first two brachials united by syzygy *stelligera*-group.
 - b. The first arm-syzygy in the third brachial *valida*-group.
- IV. Three distichals, the first two articulated, the third axillary with a syzygy.
 - a. First arm-syzygy in the second brachial *fimbriata*-group.
 - b. First arm-syzygy in the third brachial *parvicirra*-group.

1. The *solaris*-group contains three species which inhabit the Eastern Archipelago, but extend northward to the China Sea and southward to the coast of Queensland as far as latitude 24° S. They are limited to shallow water, 12 fathoms or less.

2. The *paucicirra*-group includes only two species, one of which was obtained at Mergui and the other is abundant at Torres Strait. They are shallow-water forms.

3. The *typica*-group contains four species which are all confined to the Eastern Archipelago and Western Pacific. Three are purely littoral species, but the fourth has been dredged near Fiji from a depth of over 200 fathoms.

4. The *echinoptera*-group includes six species, five of which are members of the Caribbean fauna, with extension to the coast of

Brazil and the Bahamas (one even passing to the East Atlantic), and the sixth from Malacca and the coast of Queensland. The bathymetrical range is from shallow water to probably 830 fathoms.

5. The *stelligera*-group contains four species, one of which is found on both sides of the Atlantic and possibly also in the Eastern Archipelago; but all the other members of the group are limited to the latter region and the Western Pacific. The bathymetrical range is from shallow water to probably 830 fathoms.

6. The *valida*-group comprises four species, all of which are confined exclusively to the Eastern Archipelago, including the Fiji and the Friendly Islands. All are shallow-water forms.

7. The *fimbriata*-group includes seven species, two of which inhabit the Caribbean Sea, while the remainder of the forms are limited to the Indian Ocean, the Eastern Archipelago, and the North-west Pacific. Of the Atlantic species one possibly ranges down to 88 fathoms, while the other occurs between this depth and 118 fathoms. The eastern species all belong to the purely littoral fauna.

8. The *parvicirra*-group contains twenty species and is more widely distributed than any other in the genus *Actinometra*. It is represented on the Peruvian coast and at Tahiti, is abundant at Samoa, Tonga, and Fiji, and extends through the Eastern Archipelago to Japan on the north and the Nicobar Islands on the west. It also occurs at Natal and Simon's Bay, and is represented by one species on the southern coast of Australia. The bathymetrical range is from shallow water to 210 or 255 fathoms.

Promachocrinus, Carpenter, is characterized by the presence of ten radials in the calyx instead of the usual five. In all other respects there is no essential difference between this genus and *Antedon*. It is represented by three species, one of which was obtained at a depth of 500 fathoms off the Meangis Islands and the other two from localities in the Southern Ocean, one from shallow water down to 75 fathoms off Kerguelen and Heard Island and the other from between Marion Island and Kerguelen at 1600 fathoms and from south of Australia at 1800 fathoms, where it was associated with the remarkable genus *Thaumatocrinus*.

Thiolliericrinus, Étallon, is only known in a fossil state, and has hitherto been found in Jurassic and Lower Cretaceous beds.

Geologically the history of the Comatulæ, so far as our present knowledge goes, dates from the Middle Lias, where the family is represented by the genus *Antedon*. The earliest known *Actinometra* is from the Bathonian; and *Eudiocrinus* has been found in the Lower Neocomian (Valangian).

The following summary of the distribution of the species of *Antedon* and *Actinometra* respectively presents a number of interesting facts.

The ten-armed species of *Antedon* have a wider range both in depth and in space than any other types of the genus. They are the only species which occur outside the fortieth parallels of latitude and at greater depths than 750 fathoms.

There are no tridistichate species of *Antedon* in the North Atlantic outside the Caribbean Sea, though they occur in the South Atlantic at Tristan d'Acunha and Ascension and at five stations below 100 fathoms in the Western Pacific and Australasia.

On the other hand, the bidistichate series does not range further south in the Atlantic than 10° S., though it has the same distribution as the tridistichate series in the Pacific. This group is also much more common than the tridistichate group in the Caribbean Sea, especially below 100 fathoms, and ranges to a greater depth.

The range of the genus *Actinometra* both in depth and space is very much more limited than that of *Antedon*. It corresponds very closely with the geographical and bathymetrical ranges of the multibrachiate species of that genus. The northernmost *Actinometra* does not reach 36° N., and the southernmost 38° S., and no *Actinometra* has been obtained with certainty at a greater depth than 533 fathoms; but it may probably extend to 830 fathoms. *Actinometra* is far more extensively developed in the Eastern than in the Western Hemisphere. The ten-armed forms of *Actinometra* which occur in the Caribbean Sea and along the South-American coast represent an entirely different type of the genus from the ten-armed species of the Eastern Hemisphere. Of the multibrachiate species of *Actinometra* the tridistichate type seems to be the more extensively distributed, and not the bidistichate one, as in the case of *Antedon*.

The number of described living Comatulid species is now 180; of these the 'Challenger' obtained 110, 88 being new to science and 22 previously known.

The geographical and bathymetrical limitation of the different groups indicated by the author furnishes evidence of the direct alliance and the genetic relations of the component members of the groups in a manner that comparative anatomy alone is unable to demonstrate half so forcibly or conclusively.

The monograph is illustrated by seventy magnificent plates, which for general fidelity and careful representation of detail are worthy of the highest praise. There is also an excellent index, which forms in itself a measure of the completeness and general utility of the Report.

It is no mere form of words to say that this Report will stand as a monument of patient and honest work; and we offer to the author our congratulations on having produced a memoir upon which he may look back with satisfaction and his fellow-countrymen with pride.

Tabular List of all the Australian Birds at present known to the Author, showing the Distribution of the Species over the Continent of Australia and adjacent Islands. By E. P. RAMSAY, LL.D., &c., Curator of the Australian Museum, Sydney. Pp. 38, Map. 4to. Sydney, 1888.

THE object of this Catalogue is to afford ornithologists a general

and authentic epitome of the distribution of Australian birds over the continent and adjacent islands. The well-known ornithological studies of the Author, extending over the last thirty years, and his position as Curator of the Australian Museum, have afforded him particular and exceptional opportunities of acquiring the information necessary for the preparation of such a Catalogue. A visit paid to the principal European museums whilst acting as Fishery Commissioner for New South Wales in London, during the International Fisheries Exhibition, enabled Dr. Ramsay to exchange views with the more eminent European ornithologists on the vexed and complicated question of synonymy.

The arrangement of the present work has been ordered with the view of affording the fullest amount of information in a limited space. In this difficult task the Author has succeeded, it must be admitted, with much success. No particular classification has been followed, so says the preface; but in this the Author does himself an injustice, for without adopting subdivisions which would tend to thwart the main objects of the work, the genera are placed in natural order.

Each right-hand page is arranged in tabular form, the species being numbered in serial order. From this we learn that 701 species of birds are known from all Australia, including the south coast of New Guinea, but exclusive of Norfolk and Lord Howe Islands. In 1865, at the publication of Gould's '*Handbook*,' 672 species had been recorded, but out of these only one strictly new genus had been added.

The first column of the tabular matter shows the presence or absence of the species in the Australian Museum, with this gratifying result, that 630 are there preserved. The second column affords a reference to the most easily accessible description of the bird in question, usually Gould's '*Handbook*.' The remaining columns then show geographical distribution; but as considerable territorial change has taken place since 1865, and as the names of the Australian provinces convey but an indifferent idea of the distribution of a species, the Author has given "the particular localities in which most of our large collections have been made, purposely to show the spread of certain species." The boundaries of the present and the positions of other localities are shown on a sketch-map. In the distribution-column numerals are used as the means of registration instead of the usual asterisks. The left-hand page is always devoted to notes and references, the latter being connected with the species by a running number. Separate tables are given for Norfolk and Lord Howe Islands.

We look forward with great pleasure to the appearance of a general work on the birds of Australia by the same author, which we believe has been in preparation for some time, and of which the present Catalogue is only a forerunner.

In conclusion we heartily congratulate Dr. Ramsay on the appearance of his useful and complete work.

MISCELLANEOUS.

On an Epicaridan parasitic on an Amphipod, and on a Copepod parasitic on an Epicaridan. By MM. A. GIARD and J. BONNIER.

HITHERTO no Epicaridan parasitic on Amphipods has been known. In September last Prof. Della Valle collected in the Bay of Naples two specimens of an Isopod parasitic upon *Ampelisca diadema*, A. Costa, and hastened to send them to us. These profoundly degraded Crustaceans belong to the group of the Cryptoniscians. They are adult females, one of them containing segmented ova, the other embryos ready to hatch and possessing the typical form of the first larva of the Cryptoniscians.

The whole body of the female is, so to speak, converted into a vast incubatory chamber, closed by two lateral laminae extending from the first to the fifth thoracic segment, and united in the median line, in such a way as to leave apertures for the passage of water only at the anterior and at the posterior extremity.

On the dorsal surface may be distinguished five metameric bands representing the first five somites of the thorax. On each side of the body, behind the line of insertion of the incubatory plates, we see on each of the five segments conical eminences, probably vestiges of the first pairs of feet. The head, which is strongly inflexed in front, only presents rudiments of the ordinary appendages. The maxillipeds alone are considerably developed.

The terminal portion of the body from the sixth thoracic segment is also bent towards the ventral surface, so as to complete the incubatory chamber by a posterior cavity likewise filled with ova. The sixth and seventh thoracic segments bear each a pair of digitations representing the aborted appendages and protecting the posterior opening of the incubatory chamber. This aperture therefore much resembles that figured by Fraisse in *Cryptoniscus paguri*, Fr., but the margin of the lamellae is simply thickened and does not terminate in chitinous ramifications.

The liver forms a gland faintly bilobed behind and of small size. It scarcely penetrates into the thoracic region. The digestive tube becomes dilated in the rectal part, to give origin to the ovoid organ characteristic of the Cryptoniscians. It terminates at an anus situated ventrally at the apex of the pleal mamilla, upon which traces of pleopoda may be distinguished.

This curious Epicaridan differs greatly from the genus *Cabirops*, Kossmann, which is parasitic upon the *Bopyri*; it more resembles *Cryptothiria* (?) *marsupialis*, G. O. Sars, parasitic on the Munnopsidae (*Eurycope cornuta* and *Hyarachna longicornis*). But, like the latter, it must incontestably be taken as the type of a new genus. We shall give the name of *Podascon Della Valli* to the parasite of *Ampelisca diadema*.

With the object of verifying the hypothesis formerly put forward by us with respect to the relationship of the Cryptoniscians and Dajidæ, we have made an appeal to those zoologists who possessed specimens of these exceedingly rare Crustaceans. The Rev. A. M. Norman has kindly given us a specimen of *Dajus mysidis*, Kröyer, and lent us one of an *Aspidophryxus**. We may notice here a most unexpected ethological fact—the existence of a Copepod parasitic on the latter. By a fortunate chance the specimen of *Aspidophryxus* communicated by Norman, which is attached to the back of an *Erythrops microphthalma*, G. O. Sars, sheltered beneath the posterior part of its slightly raised dorsal shield the female and two males of a very singular Copepod, which we shall name *Aspidæcia Normani*.

The female presents the form of a sac resembling a miniature *Sacculina*; in its greatest diameter (transverse) it measures eight tenths of a millimetre. The colour in alcohol is rosy. The animal is attached on the one hand to the *Mysis* by a short peduncle terminated by a sucking-disk, on the other to the *Aspidophryxus* by an elongated cord (broken in our specimen) starting from the sucking-disk and inserted into the middle of the ventral surface of the pleon of the Epicaridan. Hooked on to this cord was the male *Aspidophryxus*, it being rendered impossible for him to shelter himself as usual beneath the pleon of his female. Towards the free extremity of the body of the *Aspidæcia* two chitinous eminences are observed; then, on the side opposite to the sucking-disk, the two genital apertures, to which are appended five packets of ova. Each of these ovigerous sacs, which are nearly spherical in form and measure three tenths of a millimetre in diameter, contained eight or ten ova in segmentation.

In one of the sacs the ova were all very distinctly in the stage 4. The whole interior of the body of the female is filled with enormous ovaries containing well-developed ovules. We also observe, in the vicinity of the sucking-disk, two chitinous glands, which assist, no doubt, in the fixation of the parasite.

One of the males was attached to the *Mysis* at some distance from the female, the other upon the female herself. These males are about 150 μ in length. Their general form is very analogous to that of the males of *Sphæronella Leuckarti*, Sal. In the anterior part the cement-glands secrete a spiral chitinous filament, which serves for the fixation of the animal. The presence of several filaments upon the integument of the female indicates either that the males move about or that they had been more numerous. Beneath the organ of adherence a broad sucking-disk enables the animal to apply its buccal parts to the host which supports it. As appendages, we find outside the mouth a pair of antennæ, a first pair of

* This specimen was named *A. peltatus*, G. O. Sars, but the authors regard it as belonging to a new species which they propose to name *A. Sarsi*.

rather feeble and a second pair of very robust maxillipeds, moved by very powerful striated muscles. The terminal portion of the body is obtuse and terminated by two lateral lobes, containing the sacs for the spermatophora. These organs, which are regularly spherical, are united with the testes by fine deferent ducts.

In the form of the female and in the multiplicity of the ovigerous sacs, which are so rare among the Copepoda, *Aspidæcia* closely approaches *Choniostoma mirabile* recently discovered by H. J. Hansen beneath the branchial integuments of *Hippolyte polaris* and *Gaimardi* of the Kara Sea. With *Choniostoma* and *Sphæronella* it must enter into the aberrant family of the Choniostomatidae. The discovery of the still unknown male of *Choniostoma* will no doubt enable us to fix more exactly the affinities of this family.

Finally the relations between the *Aspidæcia* and the *Aspidophrygæus* render it a very probable supposition that *Choniostoma* is or has been parasitic upon a branchial Lophyridæ of the *Hippolyte* and has usurped its dwelling-place. A memoir with plates will make known in more detail the anatomy of *Podascon* and *Aspidæcia*, and we may be permitted in conclusion to thank MM. Della Valle and A. M. Norman, who have sent us the materials for this investigation in an admirable state of preservation.—*Comptes Rendus*, April 29, 1889, p. 902.

Spontaneous Movements of the Style and Stigmata of the Cornflag
(*Gladiolus segetum*). By M. C. MUSSET.

The author notes that movements of the female organs of plants are comparatively uncommon and calls attention to an important instance in the Cornflag. In the Iridaceæ the anthers open outwards longitudinally, so that the pollen falls upon the parts of the perianth, and can only reach the stigmata by the action of the wind, the intervention of insects, &c. In the genus *Gladiolus* the style and stigmata, by their movements, get over this difficulty.

The three stamina forming the exterior whorl of the andræcium attain their final length before the styles have commenced their growth; the two posterior lateral ones incline their filaments to the right and left of the anterior stamen, so that the three anthers are juxtaposed in the same plane. At this moment they turn their dorsal surface to the style and they are also 3 centim. longer, so that direct pollination is doubly impossible. The conerescent styles situated behind the filaments grow rapidly in the direction of the dorsal line of the andræcium and soon equal the stamina in height; but the filaments bend slightly outwards, the anthers, hitherto in lateral contact, separate, and their cells open; the styles, still growing, bend in the same direction; the three stigmata also separate and move so as to come directly beneath the anthers, from which the pollen can then fall only upon the stigmatic papillæ. Direct pollination is thus insured.—*Comptes Rendus*, April 29, 1889, p. 905.

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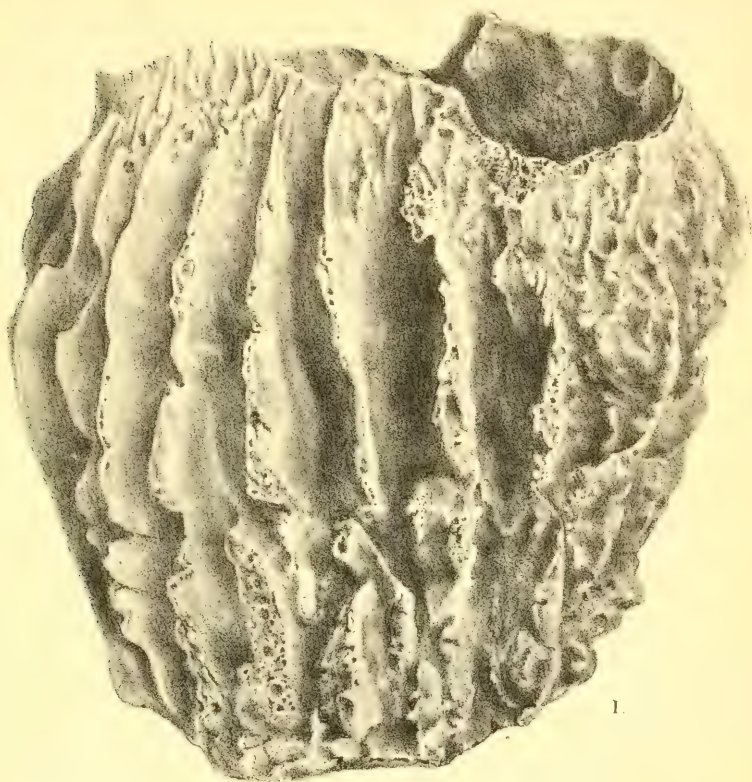
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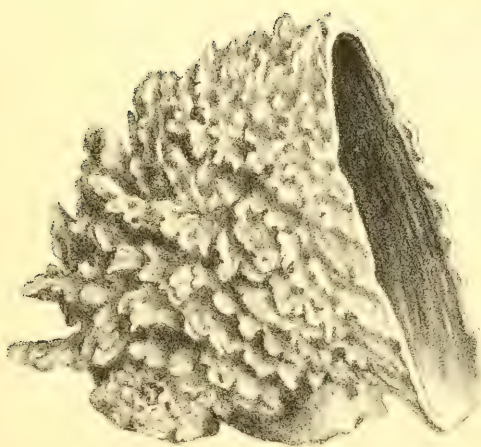
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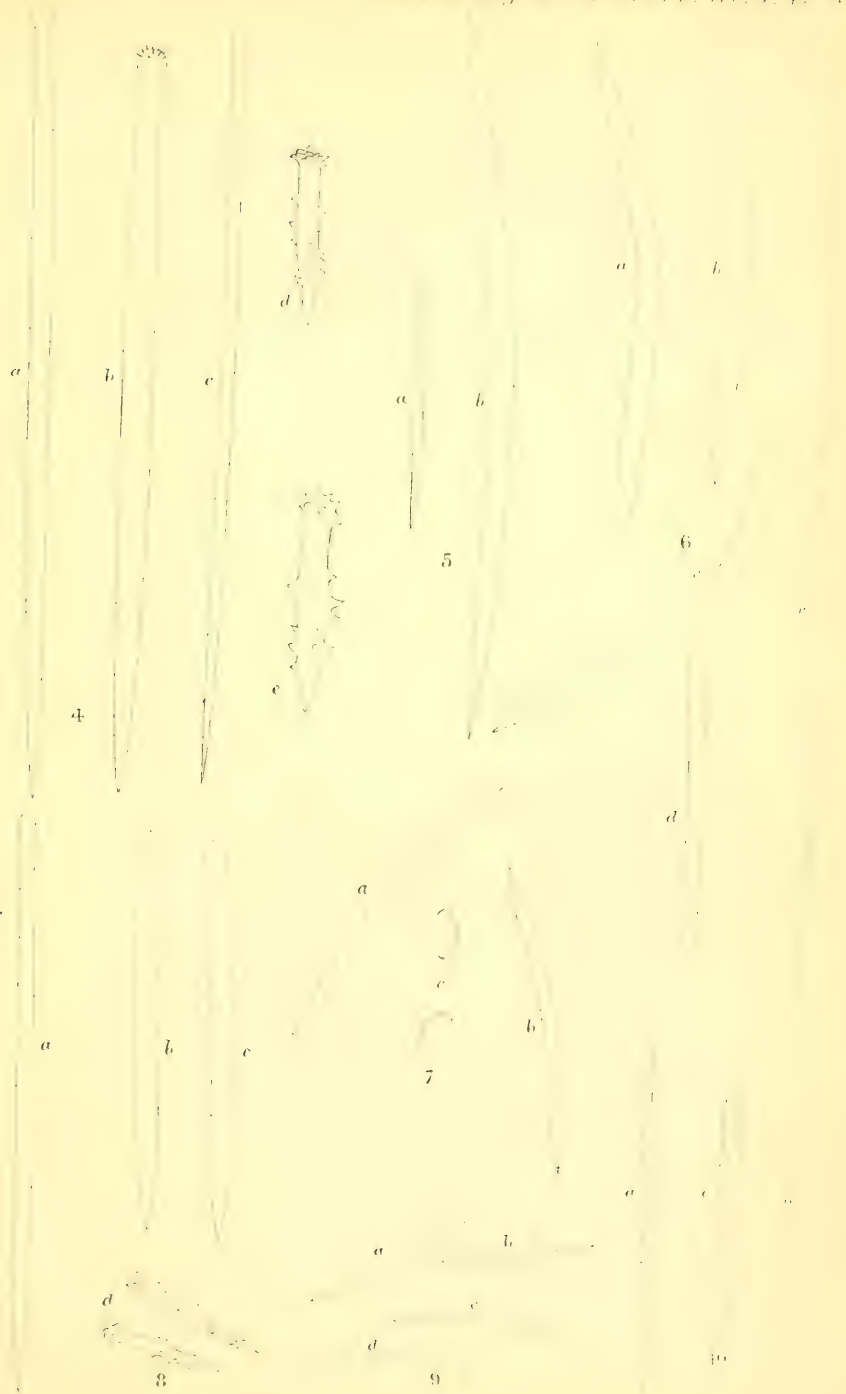
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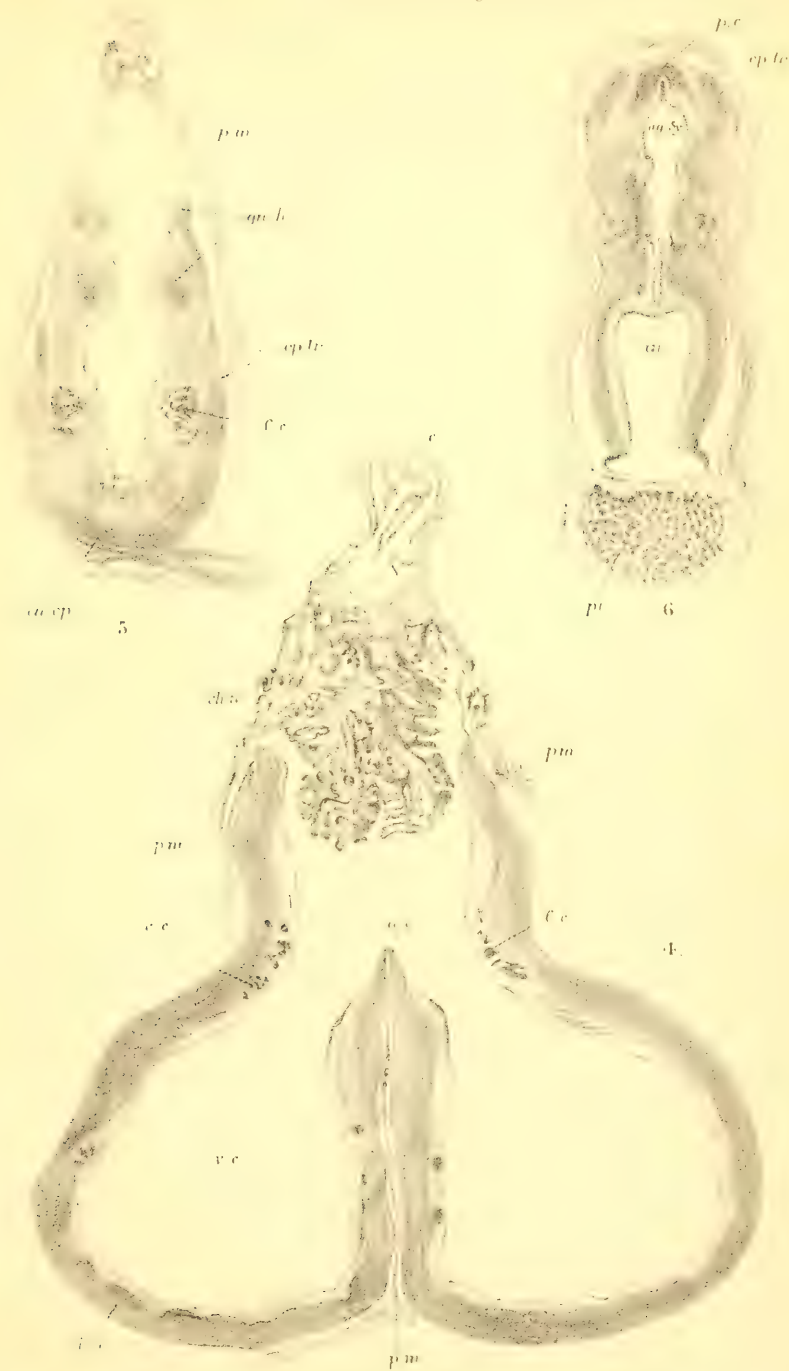
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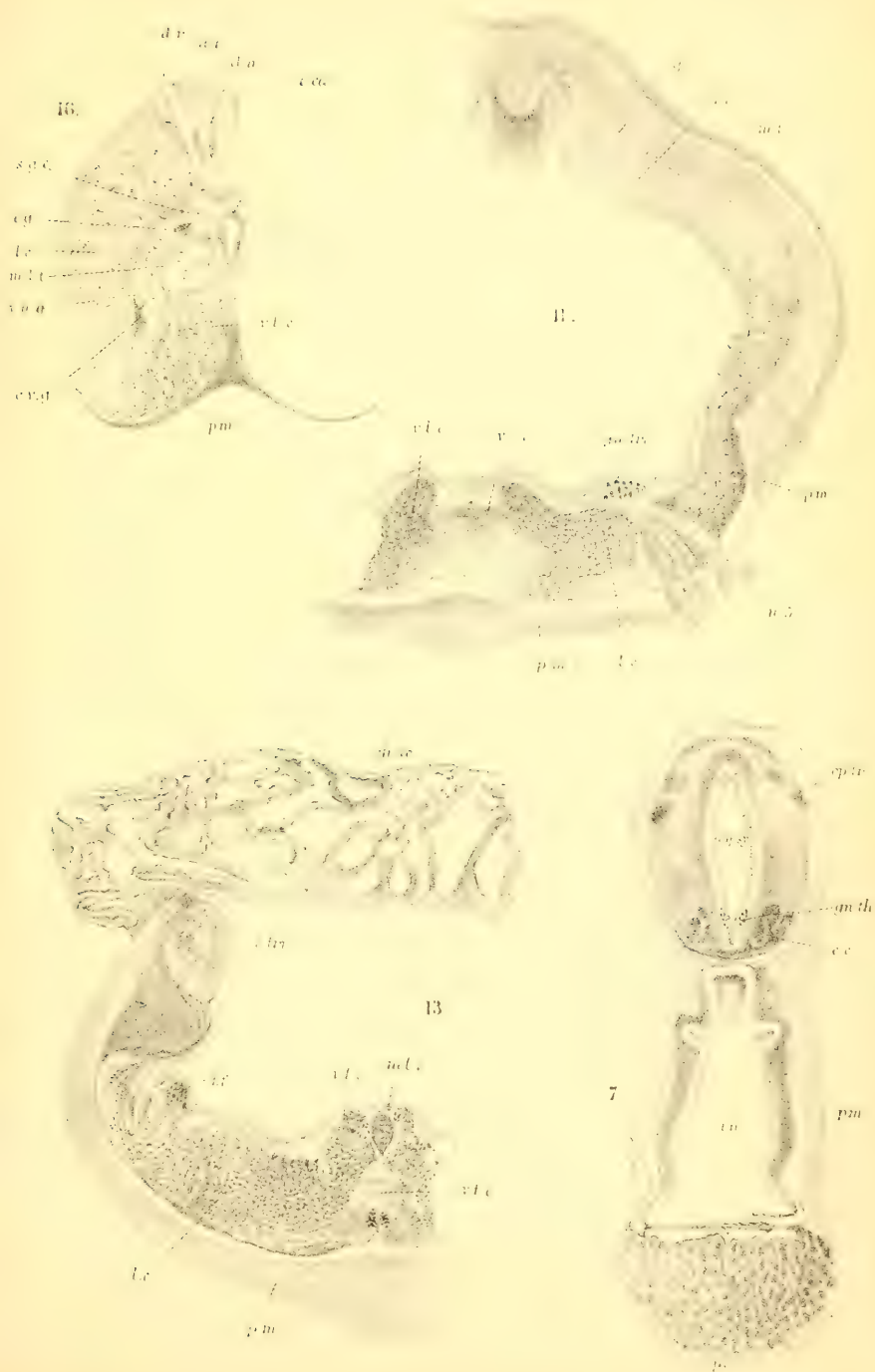
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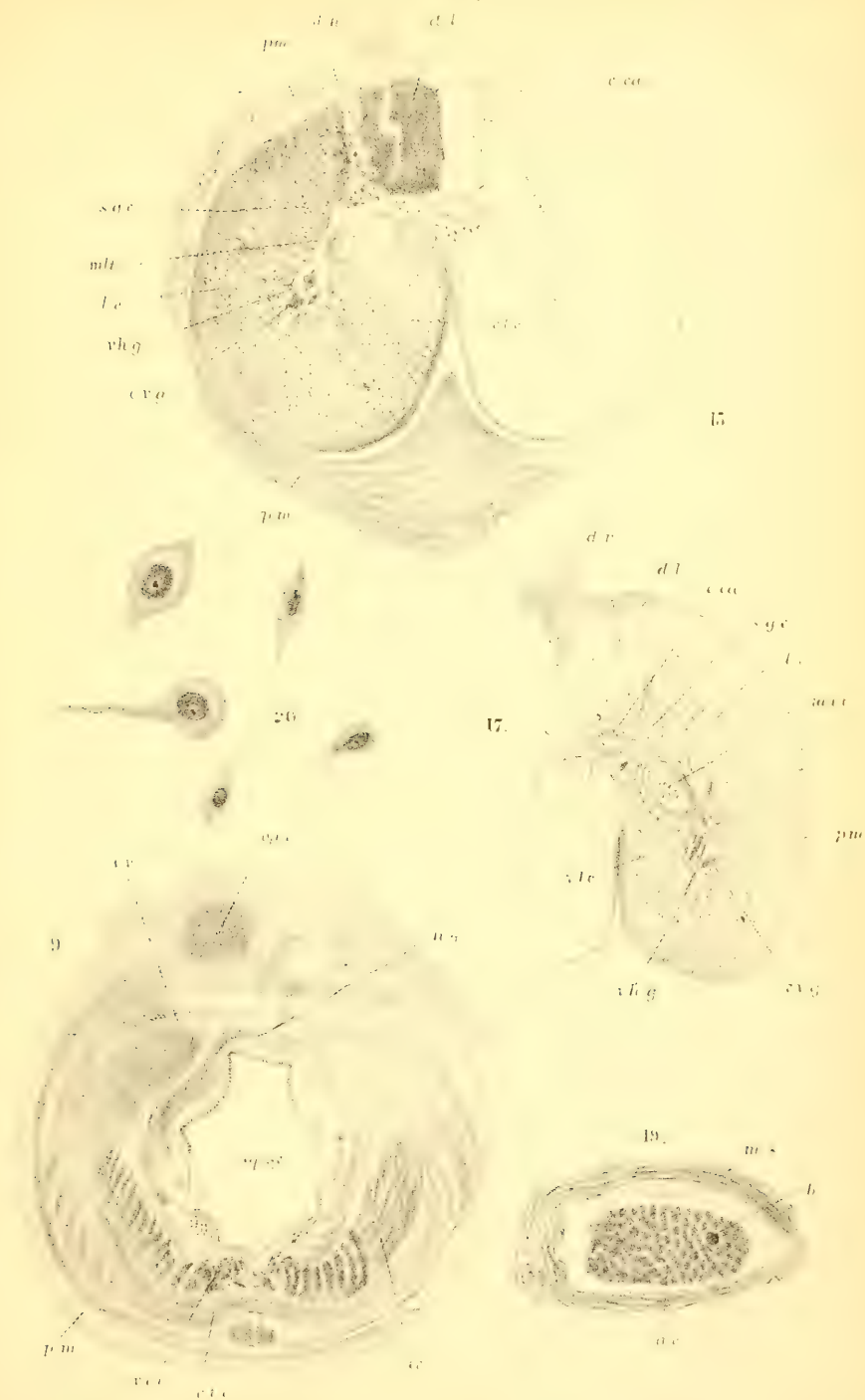
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1882









t. c. ep.

pm

pm

aq. s.

l. c.

d

3

d

v

13.

n. 5.

n. 7

n. 8

pm

12

pl. c.

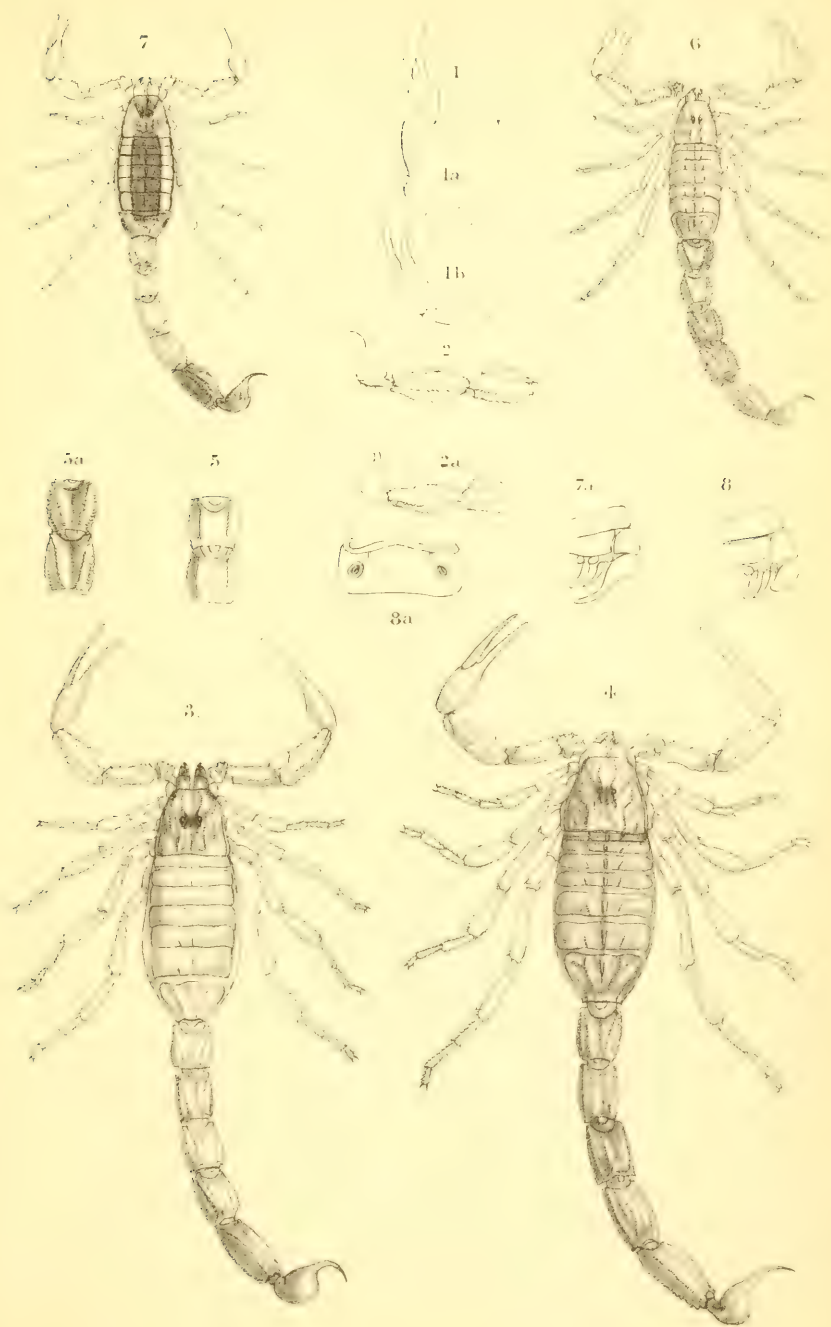
f. c.

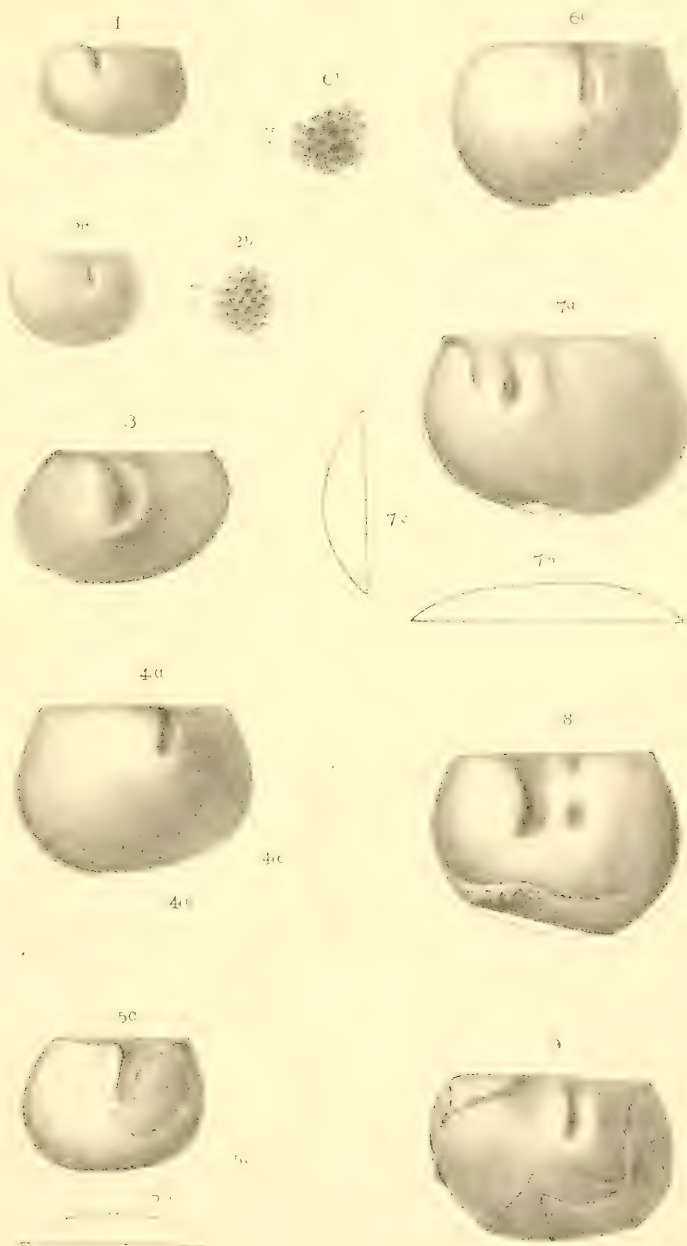
d



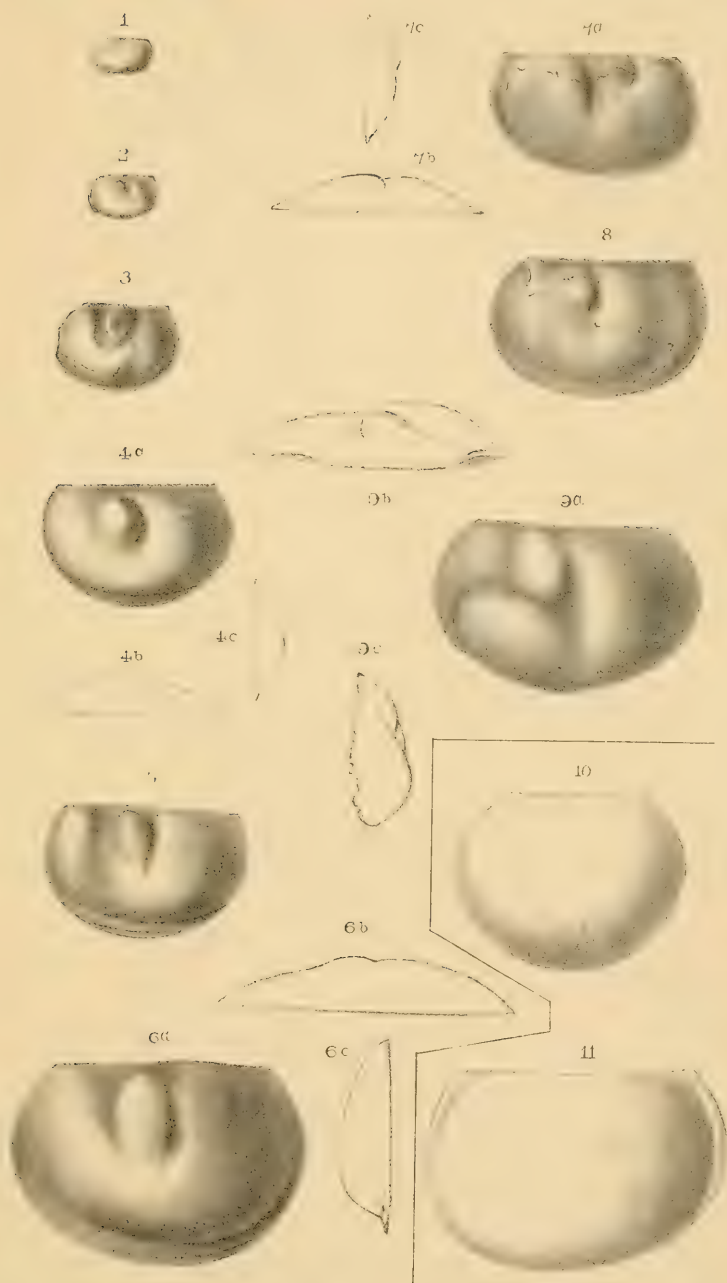


1 3. *Acrodus* (?) *keuperinus*. 4, 5. *Dipledus* *Moerri*. 6. *Hybodont* *Tooth*.
7, 8. *Saurichthys* *acuminatus*



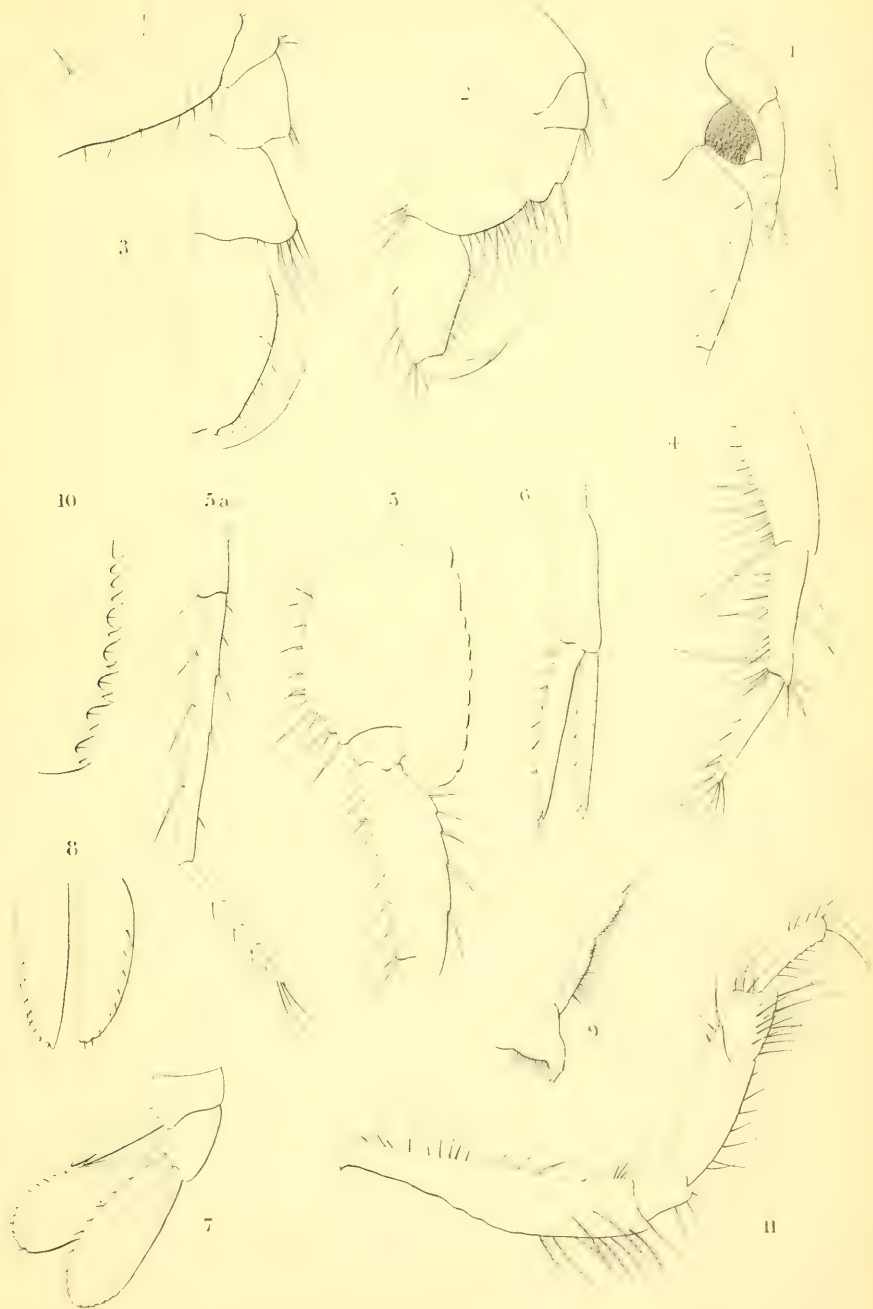


Geo. West & Sons del lith. et imp.

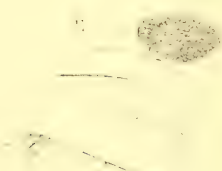


Geo. West & Sons del. lith. et imp.

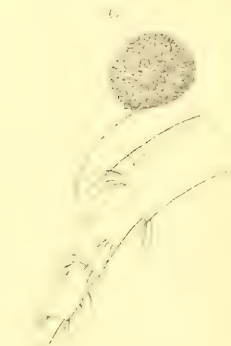
SILURIAN OSTRACODA
FROM NEW BRUNSWICK &c.



3



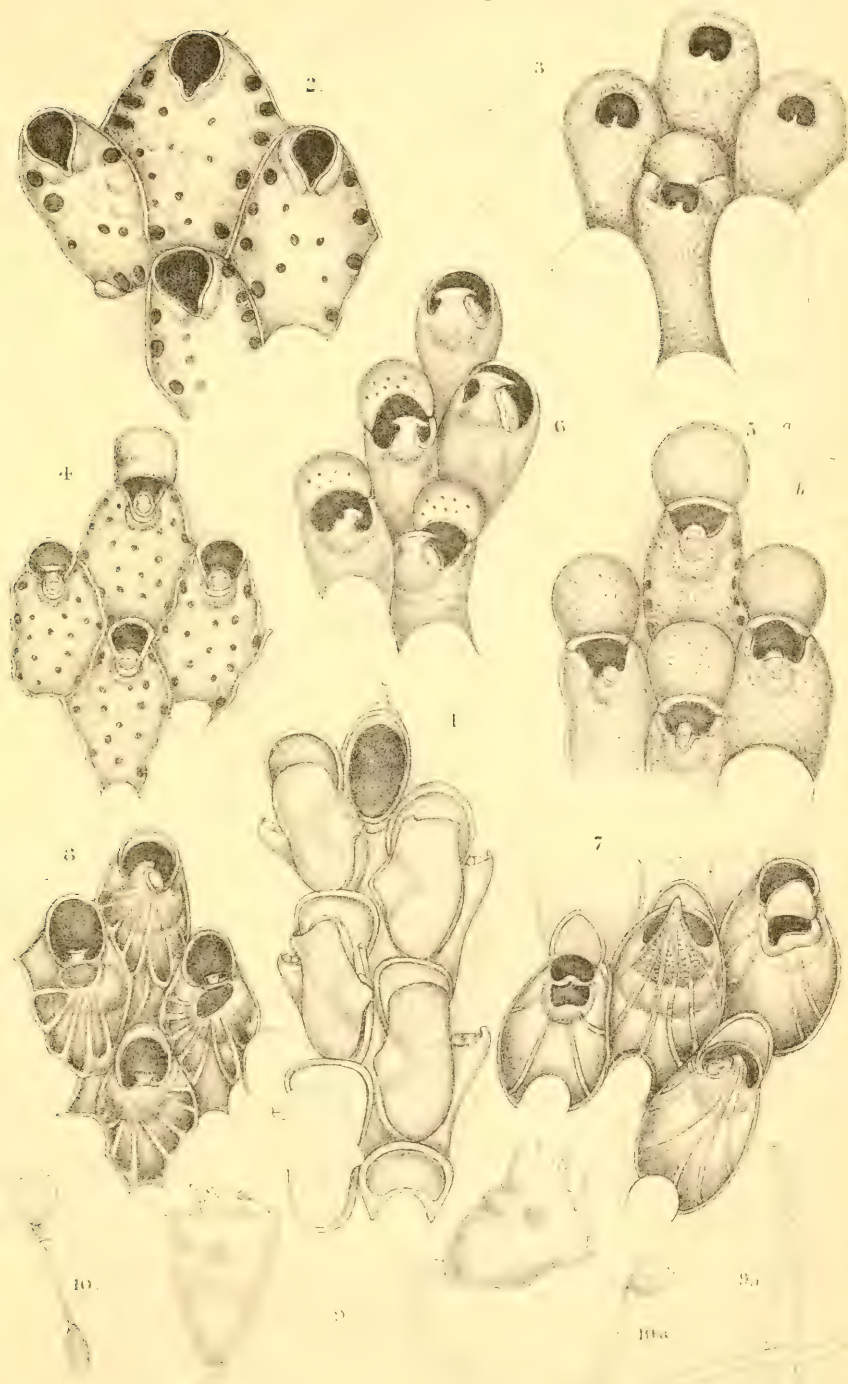
4



10











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